THE MARINE REVIEW

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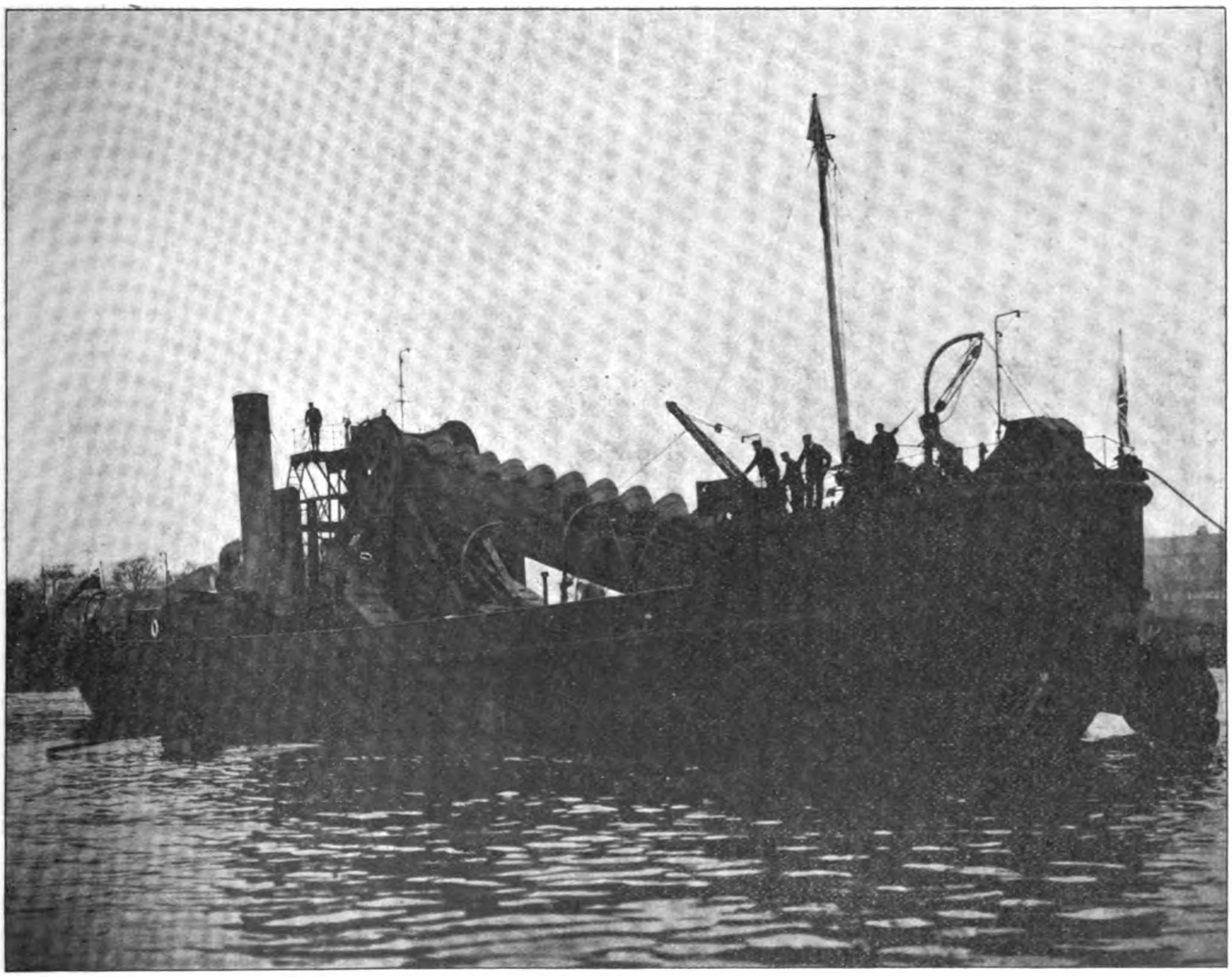
NEW DREDGER FOR NEWPORT.

For the Alexandra (Newport and South Wales) Docks & Railroad Co., William Simons & Co., Renfrew, have recently constructed a powerful 750-ton hopper dredger, built to deal with the deepening and improvement of the port of Newport, Monmouthshire, and its approaches. The dredger, which was put into the water complete with steam up and ready water level. The buckets are of special design and strength for dealing with the various classes of material to be met with at Newport and its approaches, and the nominal bucket-lifting capacity is 900 tons per hour. The vessel is propelled by two sets of triple-expansion surface-condensing engines of sufficient power to obtain a speed of about 9 knots when loaded. Either set of engines is available for driving the



THE POWERFUL MERSEY DREDGER BRUCE.

for work—the naming ceremony being performed by Mr. Macaulay, of Newport—has been constructed to Lloyds highest class for a vessel of her type. The bucket ladder, which is constructed in accordance with the builders' latest practice and most improved form of girder work is designed for dredging to the very considerable depth of 48 ft. below dredging gear, and change gear is provided so that a constant piston speed can be maintained, and the full power of the engines exerted, whether the dredger is working on hard or soft material. Steam is supplied from two large marine multitubular steel boilers constructed to Lloyds requirements for 160 lb. per inch working pressure. A complete installa-

tion of auxiliary condensing plant is provided, also steam fire and salvage pump, automatic boiler feed pump, together with full outfit of engine room auxiliaries, in accordance with the best modern practice. Independent maneuvering steam winches are provided at bow and stern for regulating the cut of the dreger, also independent steam-hoist gears for controlling the bucket ladder and the hopper doors. The dredger is electrically lighted throughout, and in all respects equipped for constant and efficient work in her destined province. She has been constructed under the direction of Mr. John Macauley, general manager of the Alexandra Docks & Railway Co., assisted by Mr. Robert Anderson, Renfrew, who acted as resident inspector.

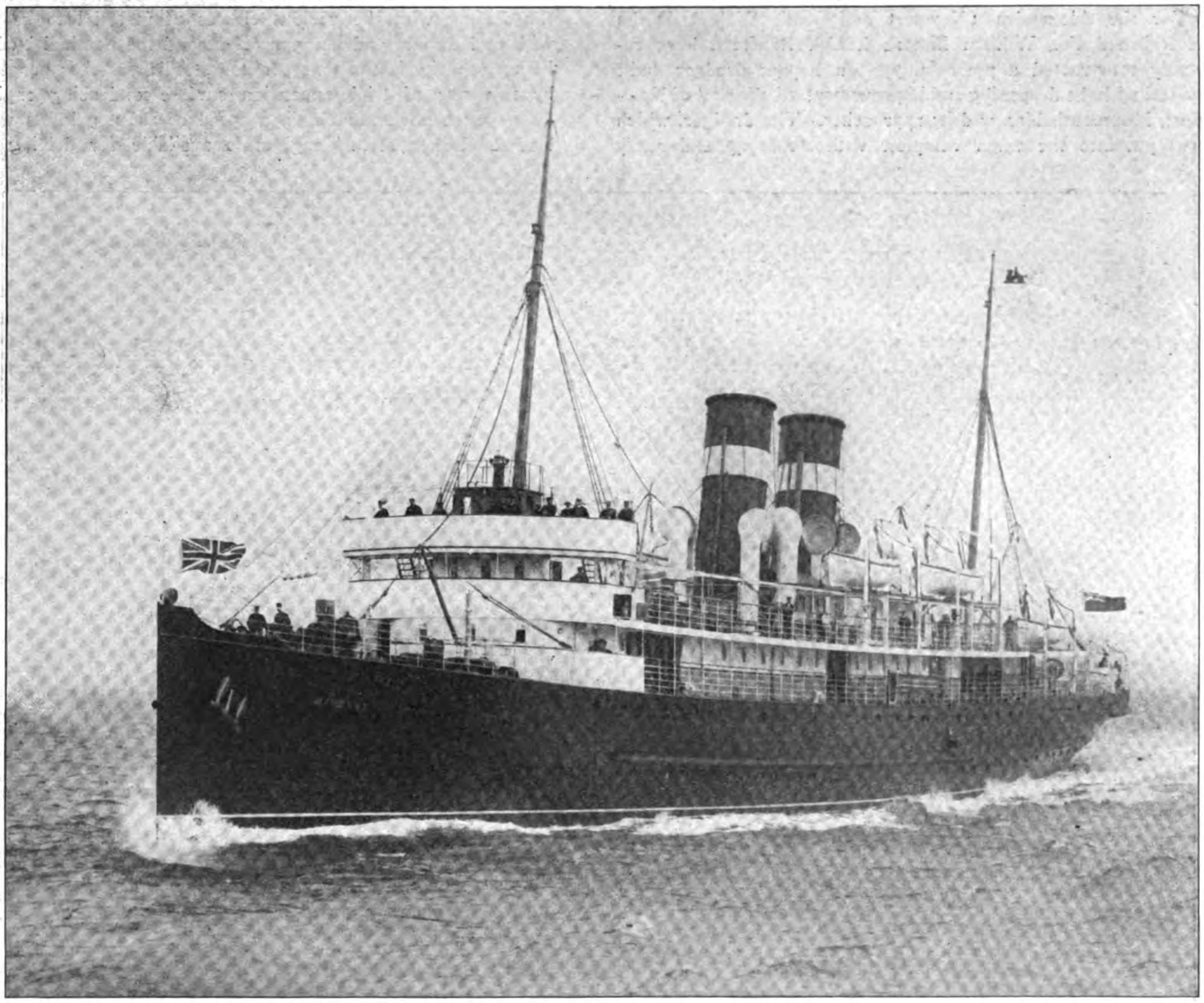
THE MANXMAN.

BY EMILE JUARINI.

A new turbine-driven steamer, called the Manxman, has been recently built at Barrow-in-Furness by Messrs. Vickers Sons & Maxim, Ltd., for the Midland Railway Co.'s Isle-of-Man service. This steamer comprises three sets of expansion turbines, the center shaft being driven by the high-pressure turbine, and each of the two side shafts by a low-pressure turbine, the astern driving turbines being mounted also on the side shafts. These latter take steam direct from the boiler.

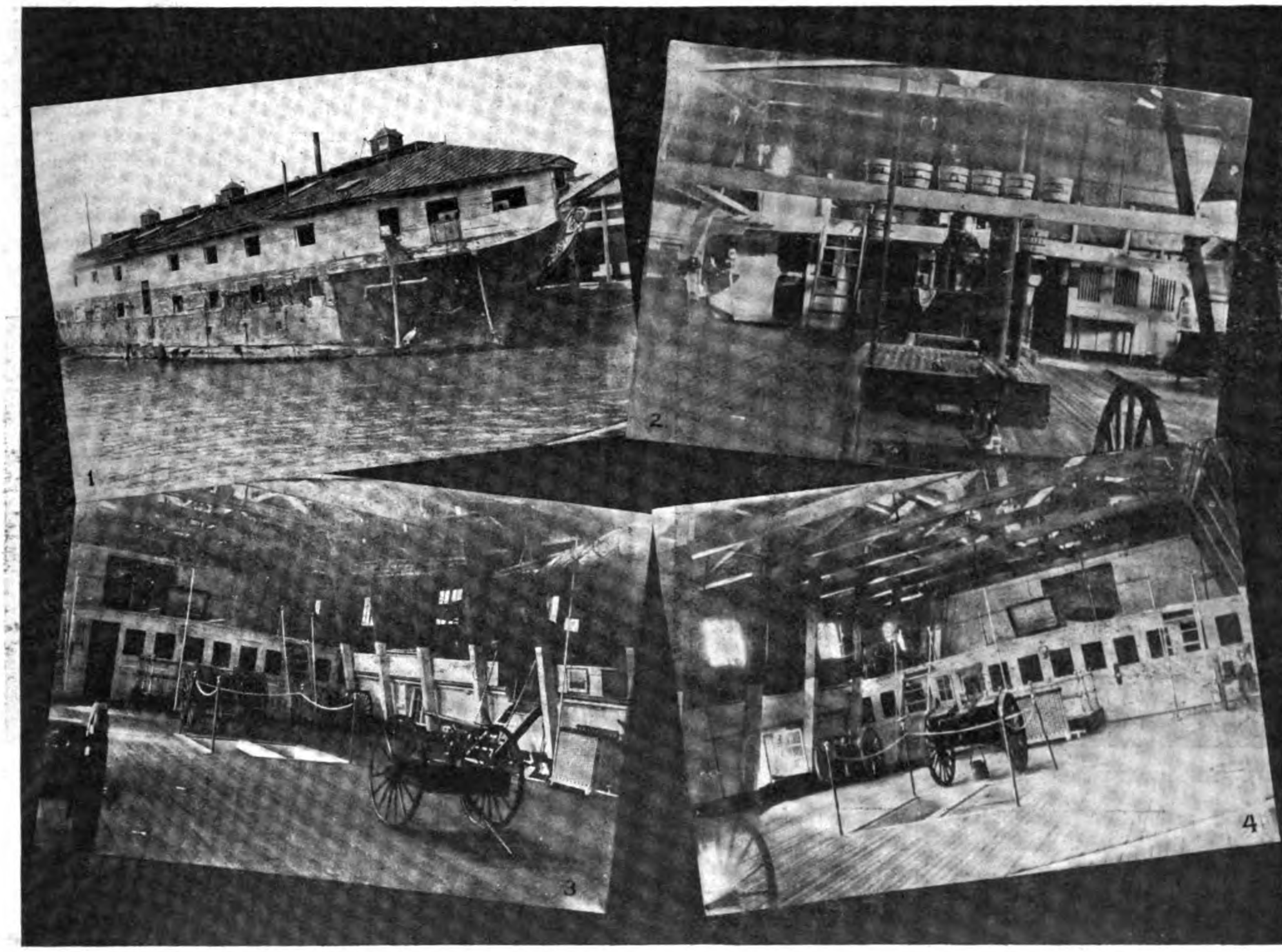
The Manxman has a length on the waterline of 330 ft., a breadth molded of 43 ft. and a depth of 29 ft. 6 in. She has four decks, one of these—the shade deck—being entirely devoted to a promenade, while the promenade deck has a considerable width on each side for the same purpose. The dining room occupies the full width of the ship, and has seating accommodation for 100 passengers. The saloon is situated at the forward end of the promenade deck, and occupies, with the smoking room, a deckhouse which extends for over 130 ft. of the length of the ship. On the deck below there are arranged the principal sleeping rooms in the ship. Many of these cabins have been made portable.

The heating and ventilating are by the thermo-tank system of the Thermo-tank Ventilating Co., of Glasgow. This system aims specially at insuring to all the living quarters of the ship a continuous supply of fresh air, which is not only warmed to the requisite degree, but is also humidified, so that none of the bad effects of over-drying can be felt. In cold weather the warmed air is discharged through a regulator into each apartment near the level of the ceiling; as



TURBINE STEAMER MANXMAN.

it cools, it gradually sinks to a lower level, carrying with it any carbonic acid gas to the passageways, where means are provided for allowing it to pass outside. The circular thermo-tanks for circulating the warm air are placed on deck. The thermo-tank consists of an electric motor operating a fan which discharges air to the outside of a tube heater. The air then passes through the tubes, and comes in close contact with the heater surface, flowing thence to the main distributing trunks. Tests have shown that where the steam-



THE OLD UNITED STATES SLOOP-OF-WAR ST. LOUIS.
THE ST. LOUIS IS NOW BEING USED AS THE RENDEZVOUS OF THE PENNSYLVANIA NAVAL RESERVES.

heated system took three hours to attain a given temperature the thermo-tank only required fifteen minutes.

The turbine machinery was constructed by the Parsons Marine Turbine Co., Wallsend-on-Tyne. There are two double-ended boilers and one single-ended boiler, and the principal dimensions of these are, for the double-ended boilers: length, 22 ft.; diameter, 19 ft. 7 in.; number of furnaces, 6; diameter, 3 ft. 11 in.; length of grate, 6 ft. 6 in.; heating surface, 4,984 sq. ft.; grate area, 161 sq. ft. For the single-ended boiler: length, 11 ft. 6 in.; diameter, 19 ft. 7 in.; number of furnaces, 3; diameter, 3 ft. 11 in.; length of grate, 6 ft. 6 in.; heating surface, 2,493 sq. ft.; grate area, 80 sq. ft. The total heating surface is 12,461 sq. ft., and the total grate area 402 sq. ft. The two double-ended boilers are placed side by side in the after part of the boiler room, while the single-ended boiler is fitted in a recess in the center of the boiler room forward, with large coal bunkers on each side. The boilers are worked under forced draft, the stokeholds being closed, and four fans are located on the upper deck, and are driven by high-speed engines, supplied by Messrs. Gaul & Co., Dumbarton.

In respect of speed, the Manxman, is three-quarters of a knot faster than the Londonderry, another Midland vessel with smaller turbines taking steam at 190 lb. pressure. Two trials were made of the measured mile and the results were the following: Mean speed of two runs, 22.141 knots; boiler pressure per square inch, 192 lb.; steam in high-pressure turbine, 180 lb.; in low-pressure turbine, port, 20 lb.; in low-pressure turbine, starboard, 20 lb.; vacuum in condenser, port, 28.29 in.; vacuum in condenser, starboard, 28.4 in.; revolutions per minute, high-pressure turbine, 553; low-pressure turbine, 609; temperature of feed water leaving heater, 180 degrees F.; air pressure in stokehold, 1.9 in. The results for the official six hours' trial were as follows: Mean speed, 22.60 knots; revolutions, high-pressure turbine, 520; low-pressure turbine, 590; vacuum, port, 28.6 in.; vacuum, starboard, 28.4 in. The vacuum was frequently as high as 29 in. In this respect a great improvement has been effected by the use of a "vacuum augmenter." In it the air pumps are placed about 3 ft. below the bottom of the condenser. From any convenient part of the condenser, preferably near the bottom, a pipe is led to an auxiliary condenser, generally about one-twentieth the cooling surface of the main condenser, and in a contracted portion of this pipe a small steam jet is placed, which acts in the same way as a steam exhauster or the jet in the funnel of a locomotive, and sucks nearly all the residual air and vapor from the condenser, and delivers it to the air pumps. A water seal is provided to prevent the air and vapor returning to the condenser. The small quantity of steam from this steam jet, which is only about 1½ per cent of that used by the turbine at full load, together with the steam extracted, is cooled and condensed by the auxiliary condenser, which is generally supplied with water in parallel with the main condenser. Condensation in a condenser takes place much more rapidly and effectually if the air is thoroughly extracted than if there is much air present, as the air seems to form a blanket round the tubes, and prevents the steam from getting free access to them.

Mr. G. A. Tomlinson, of Duluth, has gone to Europe to be away until March.

THE 25-KNOT TURBINE CUNARDERS.

There are herewith presented four views of the great 25-knot Cunarder now building at the yard of Swan & Hunter & Wigham Richardson, Wallsend-on-Tyne, England, through the courtesy of *The Engineer* of London. The pictures illustrate in a striking way a great ocean steamship "in the making," and in the earlier stages. They also give a fair idea of what the facilities are in an up-to-date modern ship yard provided with overhead electric crane equipment for dealing with the erection and conveyance of material, and with the transporting, and holding of their work, of hydraulic and other appliances for drilling and riveting material of the heaviest scantling now worked into merchant ship structures. The covered-in ship building berth on which the great Cunarder is being built at Wallsend is 740 ft. long—but can at any time be extended to 900 ft.—with a clear inside width of 100 ft. and a height of 144 ft. All the covered-in berths are equipped with numerous electric overhead cranes.

The leading dimensions of the vessels are: Length, 785 ft over all; between perpendiculars, 760 ft.; beam, 88 ft.; and depth molded, 60 ft. 6 in. They will have accommodation for over 500 first-class, 500 second-class, and about 1,200 third-class passengers. Accommodation will also be provided for a crew of about 800. With a "full complement," therefore, each of these great vessels will have a population of 3,000 souls on board. The propelling machinery, which is on the Parsons Marine Steam Turbine Co.'s principle, is being constructed by the Wallsend Slipway & Engineering Co., at Wallsend. There will be four turbines driving four shafts, each having one propeller, and the vessels and machinery are being constructed under agreement with the government to attain a sea speed not less than 24½ knots. In ordinary Atlantic weather this will enable the vessel to traverse the distance of about 2,900 knots from Daunts Rock lightship, Queenstown, to Sandy Hook, New York, in five days. Should they even fall something short of this performance these Atlantic express steamers will undoubtedly represent the highest attainment in naval architecture and marine engineering.

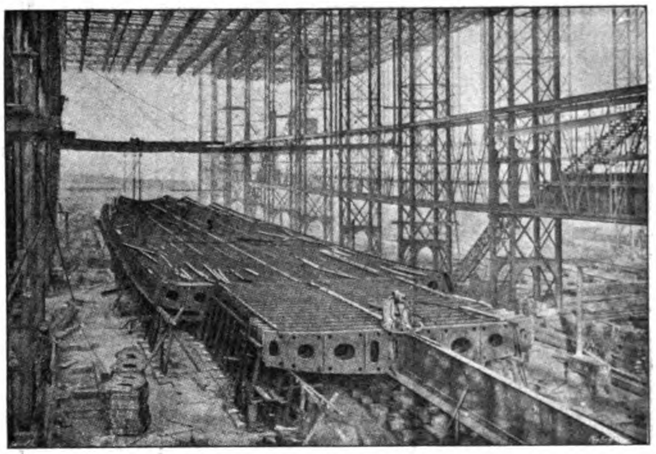


FIG. 1.—MIDSHIP PORTION OF STRUCTURAL CELLULAR BOTTOM.

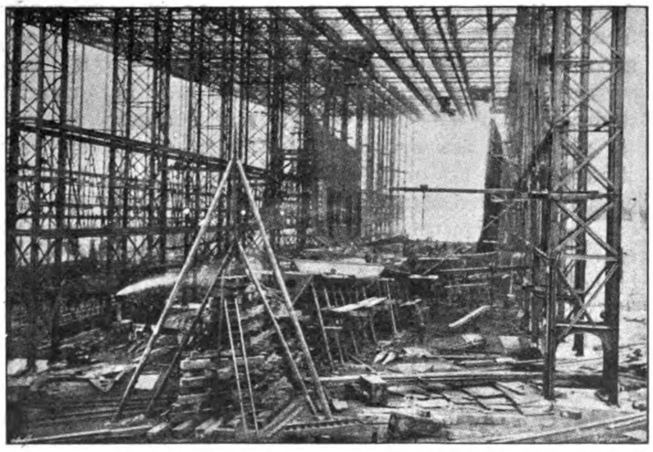


FIG. 2.—DOUBLE BOTTOM AND SIDE FRAMING FROM FORE END.

Fig. 1 shows the midship portion of the cellular double bottom of the vessel. The whole of this part of the structure, including the bottom shell plating, is riveted by hydraulic pressure, and from this view, as well as several others, a good idea may be gathered of the method of carrying out the work, and the heavy tools employed in doing it. The floors with bars attached, having been riveted together, are brought into position by means of five electric overhead cranes with which the covered-in berth is equipped—and are riveted to the center keelson by means of large-gap hydraulic riveters, these having gaps up to 6 ft. These machines are carried by light swinging jib cranes fastened to the columns of the covered-in berth. These swinging cranes are portable, and can be easily transported by the electric overhead cranes and fixed anywhere required. The overhead cranes are, of course, much in demand for transporting and erecting the heavier items in the structure. Fig. 1 in our series, taken in the latter end of November last year, is followed by Fig. 2, taken about the middle of February this year, which, besides showing the double bottom, also shows the side framing erected. Taken from the fore end this view also shows portions of the stem bar in position. Fig. 3,

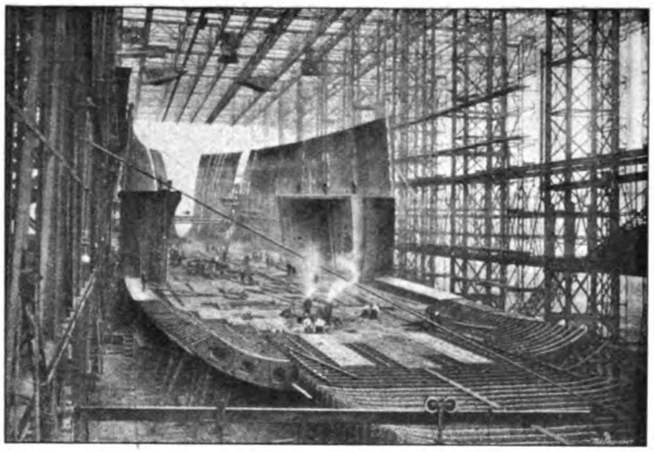


FIG. 3.—FORWARD PORTION OF FRAMING ERECTED, AND INNER BOTTOM PARTLY PLATED.

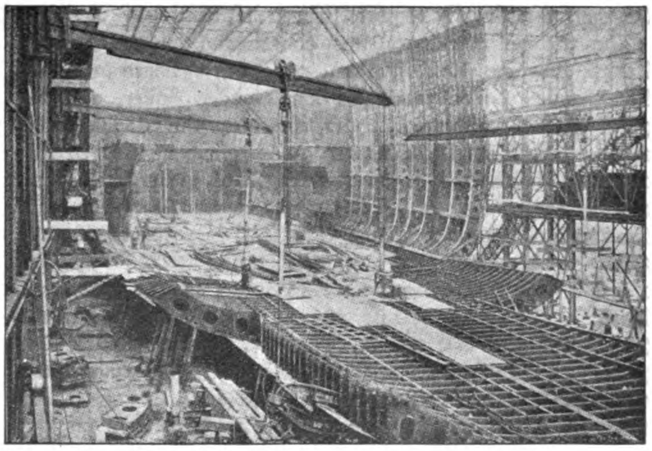


FIG. 4.—FRAMING OF FORE END COMPLETED, AND BULKHEADS ERECTED.

taken at the beginning of April, is a view from the aft end, showing the forward portion of the framing erected, and the inner bottom partly plated. The double bottom, as will be seen, extends well up the round of the bilge for the sake of increased strength and increased safety. As may also be seen, from this and other views, the framing consists of channel bars and deep web frames closely spaced. This feature is even better brought out in Fig. 4, which also illustrates clearly the mode of suspending the hydraulic riveting tools already referred to. The framing in this view, as will be seen, has been completed to the stem, and the transverse and longitudinal bulkheads are erected to level of lower deck.

WRECKING OPERATIONS END DISASTROUSLY.

New Orleans, La., Jan. 23, 1906.—All hopes of ever raising the sunken steamship Louisiana were blasted shortly before 4 o'clock this afternoon when the big steamship, without the slightest warning turned on her side in about 80 ft. of water off the head of St. Ann street and entirely disappeared from view. The attempt to raise her will be abandoned and she will either be blown to pieces or dragged further out into the stream. Two divers were caught in the bulkhead which had been built around the vessel and almost lost their lives. One of these was Charles Brooker, of Louisville, and the other George Sanford, a local man. It was only after the greatest difficulty that both men were saved. A caving bank is said to have been responsible for the collapse of the old Morgan liner. She had been lying in practically the same position for nearly eight months and there had never been any evidence of a caving bank. In fact the work was progressing splendidly and there were no indications of a collapse. It came, however, at 3:40 o'clock this afternoon and as a result the steamship Louisiana is forever lost to sight.

Many contend that the heavy bulkhead built around the vessel was responsible for her overturning. This bulkhead had been almost finished, there being only about 20 ft. of the the total 800 ft. of bulkhead yet to be completed. This remaining 20 ft. was to have been put in during the next week and at the end of that time it was planned to begin pumping the water from above the decks of the sunken vessel. The wind blowing against that part of the bulkhead which projected out of the water doubtless resulted in the vessel overturning.

The bulkhead around the Louisiana consisted of 6 x 12 grooved planking. These planks were 35 or 40 ft. in length and the lower end of each plank was bolted to the iron sides of the sunken steamship. The end was extended down until it reached the main deck of the vessel which was about 4 ft. below her rail. With this 4-ft. grip on the iron sides it was believed the bulkhead would stand the pressure necessary to raise the ship. Today's accident removes effectually all prospects of a test of the power of the bulkhead. It was simply a case of extending the vessel's sides up to and above the surface of the water. The bulkhead, built as it was, entirely around the vessel and across her bow, separated the water directly over her deck from the other water around. As soon as the bulkhead was completed it was intended to begin pumping the water from above the decks and thus raise the steamship. The engineers in charge of the work figured that it would be necessary to pump 14 or 15 ft. of water from inside the bulkhead before the vessel would move from the bottom. Then, it was believed, after that had been done she would come up one foot for every foot of water that was pumped from inside the bulkhead.

Up to 3:30 o'clock this afternoon the work was progressing splendidly. Approximately 780 ft. of bulkhead had been completed and it remained only for the engineers to close up the remaining 20 ft., complete their bracing and then begin to pump out. Two of the divers were down inside the bulkhead on the starboard, which was nearest the wharf, the bow of the boat being upstream. Suddenly the bulkhead quivered and those on the decks of the tugs and boats around noticed that it was something other than the regular "breathing" of the boat. The divers were signaled to come up, but they delayed, both being busy with braces. This delay almost cost them their lives, for within a very few moments the big vessel apparently made a violent attempt to right herself and then swung over to starboard sliding down the bank on her side in about 80 or 85 ft. of water.

The Louisiana Wrecking Co., which attempted to raise the Louisiana was capitalized at $50,000 and is said to have expended considerable money in its attempt to raise the big vessel. The big Morgan liner went down at her wharf here April 7, 1905. Her sinking was just as sudden as her action yesterday in turning on her side. Many believe that a big mistake was made by the engineers in not fastening cables from the masts of the Louisiana to the wharf and pilings in the rear. It is argued that this would have held her in position and prevented her from sliding down the bank. Others say that even this would not have saved her. The eddy at the particular spot where the vessel was lying has grown worse of late and has been persistently eating at the bank near the vessel. It gradually weakened the bank so that it could no longer stand the weight of the big ship, its 350 tons of cargo, its load of mud and the big bulkhead, and the collapse resulted. Because the Merrick Wrecking Co. had refused to try to raise the Louisiana for the underwriters much interest attached to the effort of the New Orleans firm to perform this feat.

The Louisiana was built in 1879 by Roach at Chester. Her dimensions were: Length, 320 ft.; beam, 39 ft.; depth, 14 ft. 9 in.

LINING A MARINE CROSSHEAD.

A. L. HAAS IN *The American Machinist.*

In the usual type of marine crosshead, the adjustments consist of two slippers of gray iron, attached to the enlarged end of the piston rod by oval holes and cap screws. As wear takes place, the slippers are set out to the guide faces by liners of requisite thickness inserted under them to take up wear. A ship in the Atlantic trade gave a lot of trouble with the high-pressure engine, the packing of the rod leaking badly most of the time; and pack in what fashion you might, the gland never lasted tight to the end of the trip. I received orders to overhaul the high-pressure crosshead and upon investigation, the astern slipper had a 5-32-inch liner under it, while the ahead shoe a 1-32-inch liner only. As the engine wears fifteen days on the ahead guide, and only an hour or two on the astern during any ordinary trip I proceeded to readjust matters by bringing the astern shoe metal to metal, and lining out the ahead side to fit.

When completed, I had a visit from the chief, and explained to him what had been done: showed him how the ahead side of the rod was scored by the packing, and proved to my own satisfaction that the engine was now in line; but all to no purpose. We had the old order of things reinstated. Had the adjustment remained the packing would certainly have lasted longer; the engine was grinding the gland and neck bush, and looked like scoring the rod past the ability of any packing to keep tight.

The steamer still makes her round in the same seas, and I often wonder if there is a chief aboard who knows that a marine engine always wears her guides in the one direction.

The Bay City plant of the American Ship Building Co., which was practically destroyed by fire three weeks ago, has been entirely replaced with new structures. The work was done within the time specified in the contract, twenty-one days.

SOME STERN FACTS.

BY HORACE SEE, ASSOCIATE.*

It is remarkable that the natural laws are so often disregarded, particularly in the mechanic arts, and in no branch is it more strikingly illustrated than in the vessel driven by the screw propeller. We might say that here fantastic shapes are the most popular, as shown in the propeller and the stern of a vessel. The propeller, like the Indian's boat, has received a dig from every passer-by, and all sorts of shapes suggested for obtaining the highest efficiency. The expanding pitch with the tip of blade bent aft radially so as to assume a form like a spoon was at one time a prime favorite, but today has given place to the true screw. The latter, after a thorough investigation, was accepted by the writer to be the one, when properly designed, best suited for propelling a vessel, whether the stern was full or lean, as it offered the least resistance in its path whilst obtaining maximum effect. The success with the bronze blade is in the same line, as it is to the thin blade offering less resistance than the thicker iron one, and not to the kind of metal, that this result is due. The frequency, therefore, with which this partiality for the spoon-shaped blade was expressed led the writer, when a contract had been obtained some twenty odd years ago for two vessels similar in every respect, to suggest, in order to solve the problem, that one be fitted with a blade in the form of a true screw and the other with one spoon shaped. These wheels were made solid, the outline as well as thickness of the blades being the same, the only difference being that the one was bent to form a true screw, whilst the other was expanded or twisted to make the spoon shape.

When the vessels were ready to launch with the wheels in place they were visited by quite a number of persons, from whom the general expression was in favor of the spoon-shaped blade, as it was said by them to take hold of the water better than the true screw. This view was quite true in one way, but not in that desired for obtaining the best results in propelling the vessel, as the one with the true screw was driven at a speed one knot greater than that with the spoon-shaped wheel. This result could not be attributed to the form of the one vessel or the character of its machinery being superior to that of the other, or to the handling of the vessels, but to the wheels themselves, as a new wheel of the true-screw pattern when it replaced the spoon-shaped one brought the speed of this vessel up to that of the other. Again, when the one first fitted with the true screw broke this wheel and had the spoon-shaped one that had been taken off the other vessel placed on it, then her speed also was reduced as in the case of the vessel originally fitted with this wheel.

A tunnel arched longitudinally with its lowest point at bottom of vessel forward of the screw, increasing and attaining its highest point over it and then descending to a point at or below the water line at the stern, is another form that has fascinated many. The United States Government has had a number of vessels of this type built, the contractors for which have lost a considerable sum of money—some having gone into bankruptcy—by failing to secure the contract speed. The original and altered form of stern are shown in Fig. 1. These boats were designed to maintain a speed of 29 knots for two consecutive hours. The Perry having attained but 28.2 knots on the progressive speed trials, the contract speed demanded was afterwards reduced to 26 knots, and the duration of run to one hour. The hook at stern was also removed and new propellers placed on two of the vessels. The Paul Jones gave the best general results—attaining after the change 28.91 knots on the progressive speed trials and 27.4 on the one-hour's run. The location of propellers and the form of run, still being bad, worked against attaining a higher speed. The change of trim in this vessel is not given, but that of the others averaged 5½ ft. The selection of this form of stern is more remarkable in view of the experience in 1889 with the dynamite-gun cruiser Vesuvius, contracted to attain a speed of 20 knots per hour, when tried in 4½ to 5 fathoms or comparatively shallow water.

FIG. I.

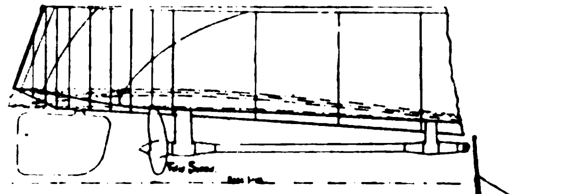


FIG. II.

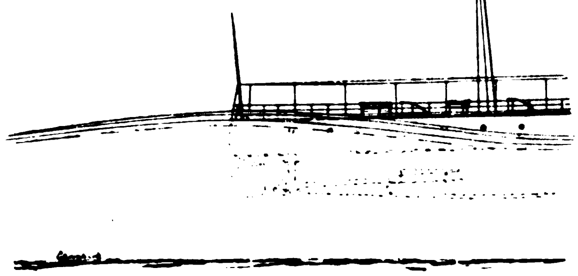


FIG. III

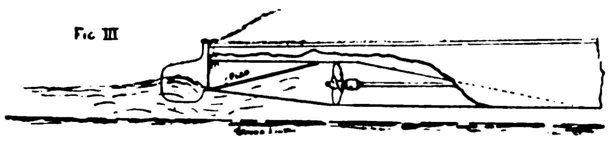
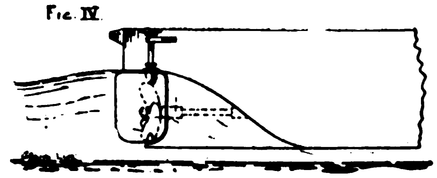


FIG. IV



The trials, four in number, with this depth of water were unsuccessful. The writer, who was present only on the last one, suggested after that failure a course where the depth of water would not be less than 15 fathoms. This met with favor, and when the next or final trial was made the vessel readily attained a speed of 21.65 knots or 1.65 in excess of the contract requirements. She had extremely fine lines, with a wedge-shaped and not an overhanging stern. On this occasion she stood up without squatting aft and with but very little disturbance in the water, whereas, in the former trials the stern not only was depressed, but a wave was formed with the crest of it so high as to cover the deck at this point, as shown in Fig. 2, thereby demonstrating that the water where depth is limited will, when leaving the stern, ascend naturally without mechanical means.

This now brings me to the tunnel stern with an adjustable flap, as shown in Fig. 3. Why a flap at all, is difficult to understand, not only in view of the experience with the above-mentioned torpedo-boat destroyers, but also from the experiments with a shallow-draught launch fitted with a tunnel and hinged flap; of which it is stated in the Transactions of the Institution of

*Paper read at the Milan meeting of the International Navigation Congress.

Naval Architects, of 1903, page 190: "When the launch is light, drawing 11 inches, with the same power the speed is increased from 9.2 miles an hour with the flap down to 10 miles an hour with the flap up; and when the draught is 28 inches, loaded with 20 tons, the speed is increased from 6.9 miles an hour with the flap down to 8.25 miles an hour with flap up, the power at both speeds being the same. As might be expected, the increase of efficiency due to the lifting of the fan is greater when the boat is loaded, the lower speed in each case being what it would have been if there had been no adjustable flap, clearly showing the advantage of the flap." Is not this an admission that the vessel would be better without the flap, meaning the same as the expression that "a dead Indian is the best Indian?" Then why should there be a flap if the boat does better with it raised? Why should it be employed to make the tunnel longer, thereby decreasing the displacement and with it increasing skin resistance? It is also said "that the rush of water being in an inclined direction towards the bottom, rather tends to scour it," but there is a failure to inform us whether the scouring leaves a true or a roughened surface. It is perfectly natural to suppose the latter is the case, and that the flap, not only a disadvantage but also an unnecessary appendage, did project the water downwards to form bridge holes, thereby retarding the vessel in shallow water and demanding greater power to do the work, a result similar to what it would be in the case of a vessel with a roughened bottom, as described in the paper of Capt. Suppan before the seventh congress. A screw, however, working in a tunnel with the air from the sides excluded and a free discharge aft seems to be a more desirable formation. It also seems that if the after portion of each side is made to form a rudder, as shown in Fig. 4, an additional advantage is gained in being able to steer a straighter course, as the full surface of the rudders is brought into play, a result not accomplished with the flap, as such a vessel is said to steer badly, the reason, no doubt, being that the water is projected downwards and away from the surface of rudder in proportion to the depression of the flap. With double or twin rudder its position in this arrangement not only affords protection, but also permits the quadrant or tiller being placed below the deck and also in a protected position.

The conclusions drawn by me from the above in re the movement of a vessel through a fluid have been as follows:

1. That all vessels create one or more waves.

2. That their chararcter at the stern is partly molded by the shape at this point.

3. That the height of waves above the normal water level is governed by the speed of vessel through the water and the latter's depth under the vessel.

4. That the wave at stern in shoal water answers the purpose of a flap, without restricting the flow aft and with least resistance.

5. That the discharge from a screw propeller should not only be free, but without restriction aft of it, no matter what the depth of water or at what speed the vessel moves through it.

6. That discharging the water downward at the stern will scour the bottom and form bridge holes to a greater extent than if discharged directly astern.

7. That the depth of bridge holes will be in proportion to the intensity of the discharge and proximity of the wheel to the bottom.

8. That a tunnel or form of stern directing the water to the screw propeller is valuable when its run limits the amount of skin friction and when it expands aft of the propeller.

9. That the propeller should be placed sufficiently far aft to limit the skin friction from the stream set in motion.

AUTOMATIC LIFE BOAT HANDLER.

The Irvine-Lihon automatic life boat handler has received some fine indorsements during the past few months. It is intended to facilitate the launching of life boats. The contrivance, a sort of hand winch, is affixed to each davit, and occupies a deck space of 14 by 24 in., in addition to that occupied by the operator. The turning of a crank causes a bull pinion wheel to engage and turn a drive (cog) wheel, which operates a drum and hoists the boat out of the chocks. The detachment of the crank shaft disengages the bull pinion from the drive wheel, and connects the former with a clutch in a worm; this gears the worm with a cog wheel on a davit, and so turns the latter. When—with davit outboard—a safety pawl, the office of which is to keep the drum from turning, is released, the operator takes hold of a safety brake handler, which he eases up to quicken or holds down to check speed, and lets the boat go into the water. The same operations are required to bring the boat up and inboard.

With this device the entire work of hoisting, swinging out and lowering away is done by two men—one at each davit—in from one-half to one minute, and in any sort of weather. The men, as is shown, have perfect control, and thus can choose the auspicious moment in which to drop the boat as far away as possible from the ship's side —indeed. Captain Raymond says it "can be thrown out forty feet away from the ship."

Wire rope is used for the falls, because it can neither burn, freeze nor expand to jam the block, as will manilla; and, as it runs on a drum, it is always clear and cannot kink. No guy is required, and the automatic handler can be attached to any davit in use today. It renders the life boat always ready—night and day—and without any preparation; there's only a handle to be turned. Its operation requires no expert or able seaman; the engineer crew is quite as much at home with it as is the deck department —indeed, landsmen can handle it with equally good results. It can be used on life rafts as well as on boats.

Besides installing the device on the Providence, the new boat of the Fall River Line, the company has ordered it for the Priscilla and Puritan. The Old Dominion Steamship Company has ordered a trial test. It is in use on the City of Erie, of the Cleveland and Buffalo Line; on the Indiana, of the Goodrich Line, of Chicago, and on the Summer. of the United States Army transport service and the General Meigs, of the quartermaster's department. There could be no better commendation of the device, as all will recognize who are acquainted with the up-to-date manner in which this ably administered department equips and appoints this very important branch of the army service.

The rights are controlled by James S. Barcus and W. F. Hallam, with offices at No. 111 Fifth avenue, New York, who have organized a company to market it.

An electrically operated freight boat is running on the Volga river, between St. Petersburg and Rybinski, covering a distance of 600 miles or more. The boat, or rather barge, is of iron construction, and measures 74 meters long and ten wide. It has three screws, each of which is driven independently by a direct-current motor. Power is furnished by three Diesel engines of the four-cylinder type, direct coupled to continuous current generators, which furnish the current for the motors. The dynamos also furnish the current for lighting, pumps, and lifting apparatus of the boat.

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RIVER AND HARBOR APPROPRIATIONS.

Among the least known the appropriations for rivers and harbors are among those which benefit the country at large to the greatest extent. As early as 1820 the United States made appropriations for river and harbor improvements; but at no time has this part of the government expense been met with anything like the willingness of that of other expenses, especially such as those for the army and navy. It appears that most of the officials at Washington do not appreciate the value of the work accomplished under the appropriations for rivers and harbors. How many of our presidents have made mention of these improvements in their messages? When it is necessary, in the opinion of our representatives, to reduce the expenses of this government, the appropriation for rivers and harbors is either greatly reduced, or entirely set aside. This course is followed even though important works of improvement are under way and suffer thereby.

Of all the appropriations made, there is none so far-reaching in its effects for general good as that for rivers and harbors. To properly carry out an improvement requires a large force of men, a large plant, and large quantities of materials. The employment of the men is not local; but, in almost every case, men on a large work represent many states. So it is in the purchase of plant and materials; all parts of the country are called upon. After an improvement is completed, when worthy, the good effects are continued through the cheapening of transportation. Undoubtedly water offers the cheapest mode of freight transportation, especially for heavy and bulky freight. When congress takes up the matter of improving rivers and harbors as a business proposition, then the problem of "rate regulation," will be solved, at least to a great extent. Transportation by water is one of the things that a freight-producing section should be doubly thankful for.

There is no doubt that every stream which can be improved at a reasonable cost, so as to permit of practical navigation, should be improved by the government; but the improvement of the larger rivers and harbors should have precedence over the smaller ones. That is, the more important rivers and harbors should be improved first, leaving those of little importance for later consideration. To begin with, congress should not consider each locality petitioning for improvement, but should take an entire section (district) into consideration. For example, the Little Kanawha and Ohio rivers. The Little Kanawha is a small stream lying entirely within the state of West Virginia, and at least nine-tenths of the benefits which would be derived from its improvement by the United States would go to that state. Should congress, even though petitioned, expend large sums of money on such a stream when a river like the Ohio, the improvement of which will directly benefit eleven states, is unimproved? The tributaries to the Ohio have received practically more consideration than the Ohio itself. This same condition is found in harbors. There are harbors to insignificant towns securing appropriations, while those to important cities—harbors of general benefit—are given but small consideration. It is not necessary to appropriate at one time sufficient funds to complete an improvement which will require several years to effect; but enough money must be made available to properly continue the work without delay. Nor should appropriations be made for the improvement of a section here and there. This is the unfortunate condition of the Ohio. A congressman evidently wanted a lock and dam below Beaver, Pa., although the natural conditions were not favorable to that location, and it required that four such structures be built before the one below Beaver could be reached from Pittsburg (the freight producing district) during low water. The lock was built, but is of little aid to navigation under present conditions. Notwithstanding government engineers have reported the ninety-mile stretch from Pittsburg to Wheeling as the most troublesome, congress ordered the building of

a lock and dam at each 89 and 387 miles below Wheeling, thereby neglecting the upper 90 miles. The Ohio is considered because it is one of the most important rivers in the United States as a commerce-carrying stream, and it has been neglected to the benefi of many of less importance.

Other nations consider internal waterways of great importance, and have expended large sums of money for that purpose. Must this progressive nation continue in the background in such improvements, especially when they will prove of inestimable value? It is to be hoped that the chief executive will see his way clear to call the attention of congress to this matter; not in relation to any particular section, but as a public work worthy of the best consideration. When congress places these appropriations on a higher plane, then we may look for increased interest on the part of the public and the executive officers.

SIGNAL BELLS FOR BUOYS.

Submarine signaling has proved so successful that it is not surprising to find developments of the idea already brought forward for practical use. The invention of Mr. J. P. Northey, of 11 Prince Arthur avenue, Toronto, Canada, for which a patent has recently been secured in England, seeks to apply the submarine signaling principle to buoys chained to an anchor, and necessarily controlled from a signal house on the shore. The accompanying illustrations sufficiently explain Mr. Northey's invention. Briefly described, it takes the form of a buoy with an intermediate open sup-

FIG. 1.

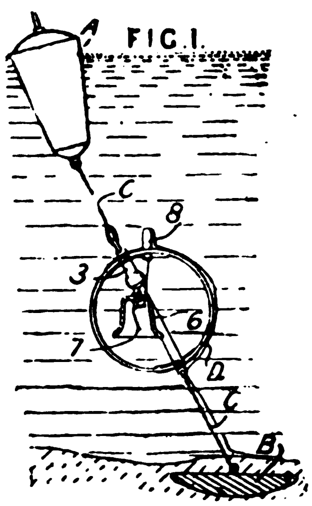
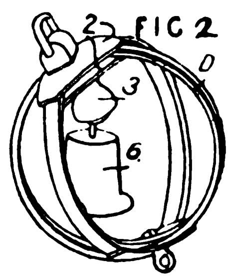


FIG. 2.



port provided with a suspended bell at a fixed distance below the floating signal. The cage or support D, Figs. 1 and 2, is attached to the chain C connecting the buoy A and the anchor B. The bell 6 is suspended by a ball-and-socket joint from the stem 3 of the upper plate, and the hammer 7 may be connected by a chain to the plunger of a solenoid 8, the electric wires of which extend along the lower portion of the chain and bed of the ocean to the signal house on shore. When for some reason the buoy is not readily discernible, it is obvious that this bell attachment will be of real value to a ship approaching some harbor or passing through a narrow sea.

The steamer Indianapolis, which was sold by the Indiana Transportation Co. to the Alaska Steamship Co., of Seattle, has reached the latter port after a sucessful trip around the Horn.

STANDARDIZING BATTLESHIPS.

The interesting feature about the trials of the British cruiser Black Prince, just completed, apart from the splendid speed achieved, is, says the *Glasgow Herald*, the fact that the machinery has been built under the new standardizing regulations, with the result that almost any unit may be taken out of the Black Prince and will fit at once into any of her sister ships. The Duke of Edinburgh, Cochrane, Natal or Achilles. The cost of this advantage is considerable, as the large number of gauges to ensure accurate diameters, of jigs to ensure that all holes on flanges and for connection by means of bolts, nuts and screws are the same, and of templates to ensure a similarity in sizes, cost about $60,000 for each ship,—equal to about five per cent on the price of machinery, including boilers. The practice now regulated is for the firms who may secure the order for one of the several sets of engines for ships of a class to agree upon the details of the design, and to arrange that each shall make the gauges or jigs for certain parts—cylinders, pistons etc. for all the engines. Thus the work of preparing the standards is divided, and as they are severally made from one pattern etc., similarity is guaranteed, and the cost minimized. But withal the expense is heavy. It is true that great advantage accrues, as in the event of break down spare parts may be more easily supplied. In the merchant service this practice has been applied for some time more or less extensively. The Scotts of Greenoch, made the London county council steamers' engines on these lines, and other cases might be quoted, but the Admirality with characteristic thoroughness extended the system—some consider needlessly far; as for instance, in the diameters of connecting rods, where there could be no interference with interchangeability. The Black Prince on her eight hours' full power trial made 23.66 knots with 23,939 I. H. P. The designed power was 23,500 I. H. P., and it was expected that this would give 22.33 knots. This gain in speed is highly creditable to the Director of Naval Construction, Sir Phillip Watts, K. C. B.—for the vessels are of 13,550 tons displacement, while in the case of the Devonshire class, the power for the same speed and a displacement of only 10,200 tons was not much less—about 22,000 I. H. P. The additional displacement represents great gain to offensive and defensive qualities, the new ships for instance having six 9.2 in. and ten 6-in. guns as compared with four 7.5 in. and six 6-in. guns.

BUILDING OF TURBINE STEAMERS.

The feature of the ship building year has not been the launching of big liners, although several leviathans have taken the water since January last, but the triumph of the turbine engine. It is no longer an experimental engine as it was ten years ago in the Turbinia, and continued to be till the projection of the Cunarders, the largest and fastest steamers the world has ever dreamt of. During 1905 the Parsons company alone has produced turbines showing an increase in horsepower of 5,400 as compared with last year, but the output of this pioneer company no longer represents the full production of turbine machinery in the country. Practically every marine engineering establishment of any importance in the United Kingdom is now able to make turbines, and this is, perhaps, the strongest testimony that could be found in favor of the new engine. Until the trials of the Carmania, it is true that engineers were somewhat sceptical as to its value, but now all doubts have been set at rest, and as the Carmania was the first example on a large scale, it may reasonably be expected that improvements in detail will still further increase the excellent results which have so far been realized.

NOTES ON THE PERFORMANCE OF THE THORNYCROFT BOILER IN A MONITOR.

BY LIEUT. W. T. CLUVERIUS, U. S. N., MEMBER.*

To have steamed 28,000 miles since commissioning, three years ago, with nearly one-third of this time consumed in repairing a turret mount at a navy yard dock, seems a fair test of the performance of the four Thornycroft-Daring boilers of the harbor defense monitor Arkansas. This type of water tube boiler has been present in our torpedo craft for several years, and trouble has been found generally in the fact that the upper rows of tubes could not be drowned and corrosion in these tubes readily set in. In the later pattern of these boilers, however, these tubes are flush with the top of the steam drum and are drowned if the boiler is kept entirely full of water. This obtains on the Arkansas, and undoubtedly the increased life of a Thornycroft boiler tube is due to this change in design, for on the Arkansas not a sign of even slight corrosion has appeared until recently. In fact, no tubes had been lost, except once through careless handling of the feed when newly commissioned, until last month. Two tubes were lost at that time in the vicinity of the steaming level, the only locality in the drum where the tube ends show any evidence of corrosion.

Assuming that the life of a tube depends upon the care which it receives, and that it is not affected by the forcing of the boiler within reasonable limits, the longevity of such tube may be determined through inquiry into the attention given the boiler.

The following is the procedure on the Arkansas, and, whether successful or otherwise, it is at least consistent:

When the fires have been burned down and the boilers disconnected, the tubes are swept with a steam lance from top to bottom while there is still pressure showing in the gauge. If in port, the uptake also. This removes much of the deposit, though not any of that which has settled in the spaces where the nests of tubes contract to enter the steam drum and the wing drum. If neglected, these spaces, for a distance of nearly a foot above the wing drums, and as much outboard from the steam drum, become entirely choked and reduce the heating surface, and therefore the efficiency, of the boiler materially. To get at this deposit, a tin scraper, together with a stiff whisk broom, is used. Each tube is carefully gone over and the interstices cleaned out. This is necessarily a slow process, but it is time well spent. Even this does not reach properly the inner corner where the rear nests of tubes enter the wing drums; and if the furnaces are allowed to remain any length of time without cleaning it becomes impossible to clear out these pockets without removing the rear casing of the boiler. As a remedy it is suggested that soot doors be fitted in the casing as in the front casing. Two such doors on each side, one just above the wing drum and the other well up in the casing, would meet the requirements.

As regards reaching the tubes of the middle water drum, much less difficulty has been experienced. With this attention in port to tubes and uptakes, the boilers have steamed freely for five days without sweeping. All of the feed water used is distilled on board, no matter whether taken from the sea or the shore. The water is given frequent nitrate tests with a standard solution at the distillers before it enters the reserve tank. The condensers receive the same test. I believe that no salt scale has ever been found in any of the four boilers. To insure an alkaline state, a small amount of sal soda is put in each main condenser every other day while underway, and in port about a quarter pound once weekly.

To prevent the passage of grease into the boilers, no oil is allowed in the cylinders and but little for swabbing the rods. The dynamo engines being steepled, with low-pressure cylinder below, and running in oil as they do, some oil is drawn up the low-pressure piston rod and it finds its way to the feed and filter tank.

The water in this tank is constrained to pass through three thick layers of loofa—a most satisfactory filtering agent—before it reaches the feed pumps. This loofa is removed every fortnight and given a soda bath, being entirely cleansed of oil. The life of a piece of loofa is about two months. It is also used in the distiller filters with excellent results. Once each month the boiler drums are opened, cleared of zinc baskets, baffles, etc., thoroughly wiped out and inspected. A solution of 25 lb. of sal soda is then placed in the boiler; it is closed up, filled to steaming level and fires are started. It is boiled out for six hours at a pressure of 50 lb. The boiler is now blown down, opened and again wiped out. The drum fittings are overhauled, after which the boiler is closed and filled with water.

Judging by the present condition of the visible portions of the tubes—and it is impossible to determine the condition of a bent tube throughout its length—coupled with the uniform attention which the Arkansas boilers have received since installment, I would submit that the period of complete efficiency of a Thornycroft boiler in a vessel of the monitor type, performing the same service as the Arkansas, is three years. After that, watch the tubes closely. There are two furnaces to each boiler, and the small grate area of each (24.8 sq. ft.) necessitates a more frequent cleaning of fires than ordinarily. In free route at sea, with the average quality of coal and under natural draft, it is often found desirable to clean one furnace of each boiler or half of the whole number of furnaces every watch. With clean coal, free from clinker or under forced draft, one quarter of all the furnaces suffices. The use of the blowers, so often demanded while steaming in squadron, through foul condition of hull or with poor fuel, has proved very trying to the furnace linings. Not only do the walls require constant patching, but the casings themselves suffer eventually, and the least warping of the front casing produces leaky furnace-door frames and also endangers the front-lining brickwork.

In common with all boilers of this type, the proportion of heating to grate surface is large (47.3 to 1), and the gases well baffled. The Arkansas can steam, under normal conditions of hull and sea, 2,700 miles at a ten-knot speed.

Probably the most interesting comparison in the operation of these boilers is that of their performance with a clean hull and with a foul one, other conditions being equal.

A, is a sixty-hour trial during a run to the West Indies, clean hull, natural draft.

B, is a sixty-one hour trial on the run north, very foul hull, natural draft.

	A	B
Distance run, knots	621.6	597.2
Average speed, knots	10.36	9.8
" revolutions	150.1	156.4
Revolutions per knot	14.5	16.
Coal per day, this rate, tons	31.	41.
Knots per ton of coal	8.	5.7
Steaming radius, miles	2,672.	1,903.8

This shows a 25 per cent increase in the daily coal consumption due to foulness alone; so that this factor, together with a heavy head sea, most of which is shipped, becomes a serious question in a monitor.

Following is a table which may also be of interest:

	A	B	C	D
Revolutions per minute	206.5	197.1	180.1	186.7
Speed per hour, knots	13.5	12.7	10.7	11.6
Total horsepower developed	*2,500	1,826.6	2,080.4	2,218.9
Pounds of coal per hour	7,200	6,720	5,471	6,859.5
" " " sq. ft. grate surface	36.4	33.9	27.5	34.6
" " I. H. P. per hour	2.9	3.6	2.6	3.1

A, is the best hour's run the ship has made, hull clean.

*From the journal of the American Society of Naval Engineers.

*Approximated.

B, is the two-hours' official acceptance trial, hull clean.

C, a three-hours' monthly speed trial, hull foul.

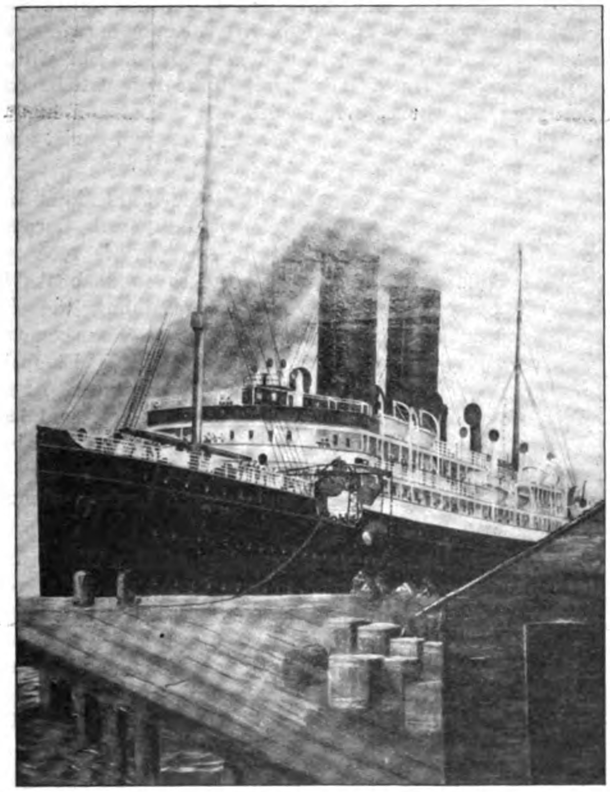
D, a four-hours' monthly speed trial, hull foul.

All under nearly similar conditions of forced draft.

Since the three harbor-defence monitors in the North Atlantic fleet have spent but little time defending harbors in these days of peace and are cruising in squadron with no reserve speed left them, the items of clean hulls and clean boilers, good coal and good firing, are very essential items indeed.

MACHINE FOR LOADING AND UNLOADING VESSELS.

Reference has frequently been made in the columns of the MARINE REVIEW to the fact that the handling of freight in coastwise ports is practically a virgin field for the inventor. Whenever a lake man goes to the coast he is astonished at the primitive methods which obtain there in the loading and unloading of vessels. On the great lakes the problem both of loading and unloading has been brought to a high state of efficiency but. of course, any comparison is unfair because

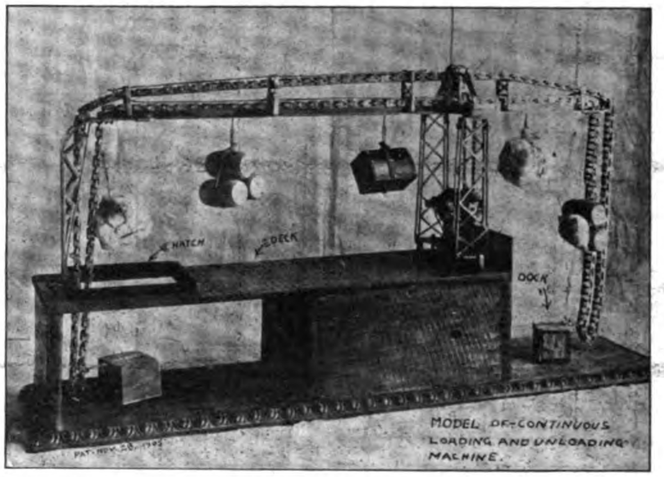


on the lakes only bulk freight is handled, such as coal, ore and grain. However, the methods obtaining on the coast are extremely primitive and it is therefore interesting to note that a machine has been invented that will handle mixed freight such as boxes, bales, barrels and bags. The inventor of this machine is Mr. Franklin B. Clark. The company known as the American Loading and Unloading Machine Co., Edwin C. Clark, president, with offices at No. 706 Fourteenth street, N. W., Washington, D. C., has been organized to put the machine upon the market.

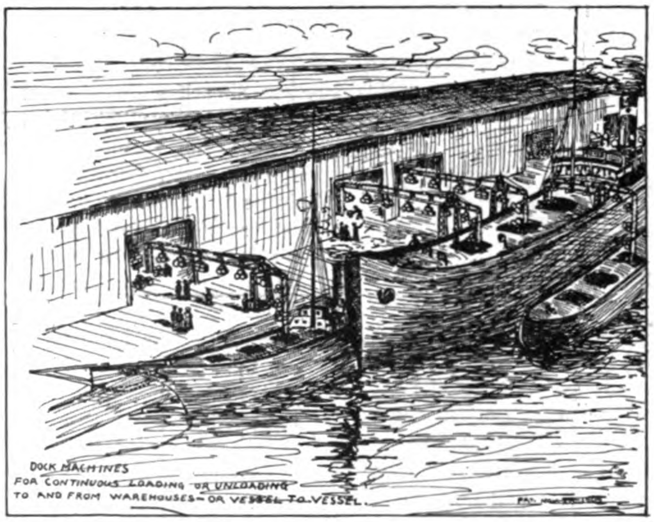
This loading and unloading machine has, outside of its general field, merits in itself, notably an anti-friction chain. In construction it is extremely simple, minimizing the chances of getting out of order. Also, after the first freight is lifted and carried to the deck of the vessel, the weight of that article going down in the hold counterbalances that being lifted from the dock, or vice versa. This means that after the start, it requires slightly more power than sufficient to run the machine were there no freight on it at all.

The machine runs by cog-chain belting driven by steam, or preferably motor power, and by reversing the power carrying freight in the opposite direction is effected. The machine is under perfect control at all times and works as rapidly as required, loading or unloading as fast as the freight can be handled.

It is built of trestle steel and varies in design and size as occasion may require. It has few working parts. As a deck-installed machine on board vessels, the important feature is pointed out that no matter how varied would be the rise and fall of the vessel by reason of the tides, or from the loading and unloading, the operation of the machine will



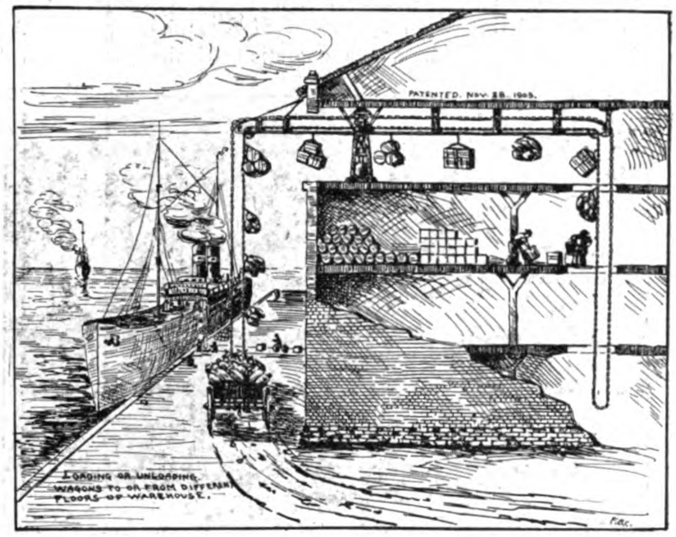
in no manner be effected. This feature extends its field of operation to an enormous warehouse business which today is even more antiquated than that of handling mixed freight on vessels. Trucks and derricks are the only two methods that can be used generally today. In the former, the weight to be trucked is necessarily limited to the strength of the man who wheels and to his ability to keep it up day after day. In the derrick system there is not only the carrying of a dead weight and swinging the arm back empty, but also



this fact: No derrick can operate or lift higher than itself, nor in an enclosure. higher than the one floor. That means that freight for different floors of a warehouse must be handled over and over again. The machine under discussion can be built as high as desired and run along the roof rafters of the highest warehouse so as to load or unload freight to any level desired.

No carrier system takes articles at right angles except by going over controlling wheels or rollers at the corners. This machine operates at right angles with an easy movement.

This enables the machine to lift over any intervening obstructions by simply increasing the length of chain. It carries in continuous motion and in rapid succession all classes of baggage or freight of a similar nature, or mixed, such as buckets or anything, bales, boxes, bags, bunches of fruit, barrels, packages of mail, etc. It will unload from one vessel to another—a very valuable device for coaling at sea. It is adaptable for interior carrying. It is a deck installed machine or a permanent machine can be erected on a dock. At



its ends an extension on a permanent erection can be carried as far as desired.

All carrier machines today or nearly all, go in one direction only, or operate from one point to another. Briefly, this machine does the work of those now in existence and reaches a field of its own heretofore unsolved, and unoccupied. By reason of the fact that the machine does not bring back the buckets or slings, it is necessary in loading coal or kindred materials to use canvas or pliable baskets which are readily attachable to the chain.

TO MINIMIZE CAVITATION.

It is not often that a noble concerns himself with maritime appliances, but Friedrich August, the Grand Duke of Oldenburg, Germany, is obviously an exception. He has recently secured a patent in England for a new idea in screw propellers, the object of which is to minimize cavitation by arranging the root points of the generating lines of the blade surface, of two or more bladed propellers on a common spiral line of constant or varying inclination drawn around the circumference of the boss.

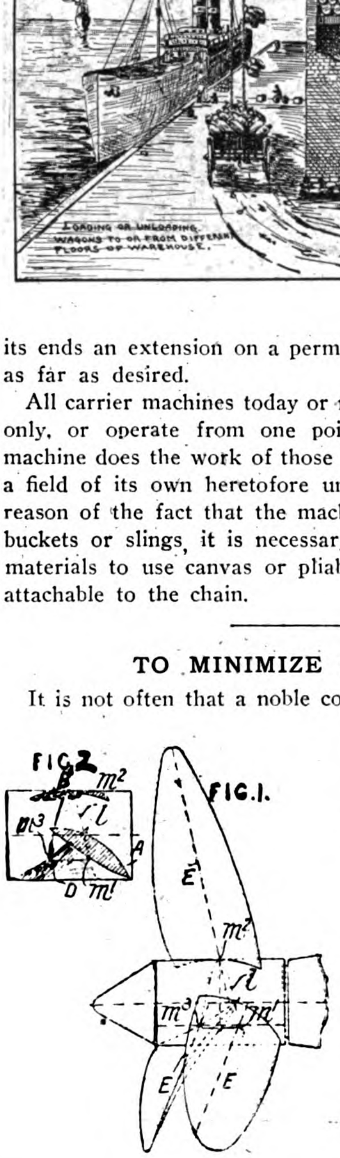


Fig. 1 shows a side elevation of a screw propeller having three blades, the generating lines E of which intersect the spiral line l at the points m^1, m^2, m^3; while Fig. 2 shows the angles the bases of the blades A, B, D make with the spiral line.

The directors of the Great Lakes Towing Co. will hold their meeting Feb. 7.

AROUND THE GREAT LAKES.

Capt. James Corrigan, of Cleveland, has sold the schooner Ashland to the Hines Lumber Co., of Chicago. The Ashland was built in 1886 and is 218 ft. keel and 37 ft. beam.

Capt. J. H. McCormick, sixty-four years old, died at Ogdensburg, N. Y., this week. He was a well known vessel master, his last vessel being the Iron Age of the Corrigan fleet.

A revised chart in colors of Lake Michigan showing the coast from Ludington to Muskegon has just been published by the United States lake survey office and is for sale by the MARINE REVIEW.

At the annual meeting of the Lake Pilots' Association, held at Detroit last week, the following officers were elected: President, C. A. Bush, of Cleveland; first vice president, John J. Cassin, of Buffalo; second vice president, Mark Crowley, of Chicago; third vice president, Robert Harris, of Port Huron; fourth vice president, Ralph Pringle, of St. Clair; fifth vice president, James Slavin, of Toledo; secretary and treasurer, Thomas Hayman, of Milwaukee.

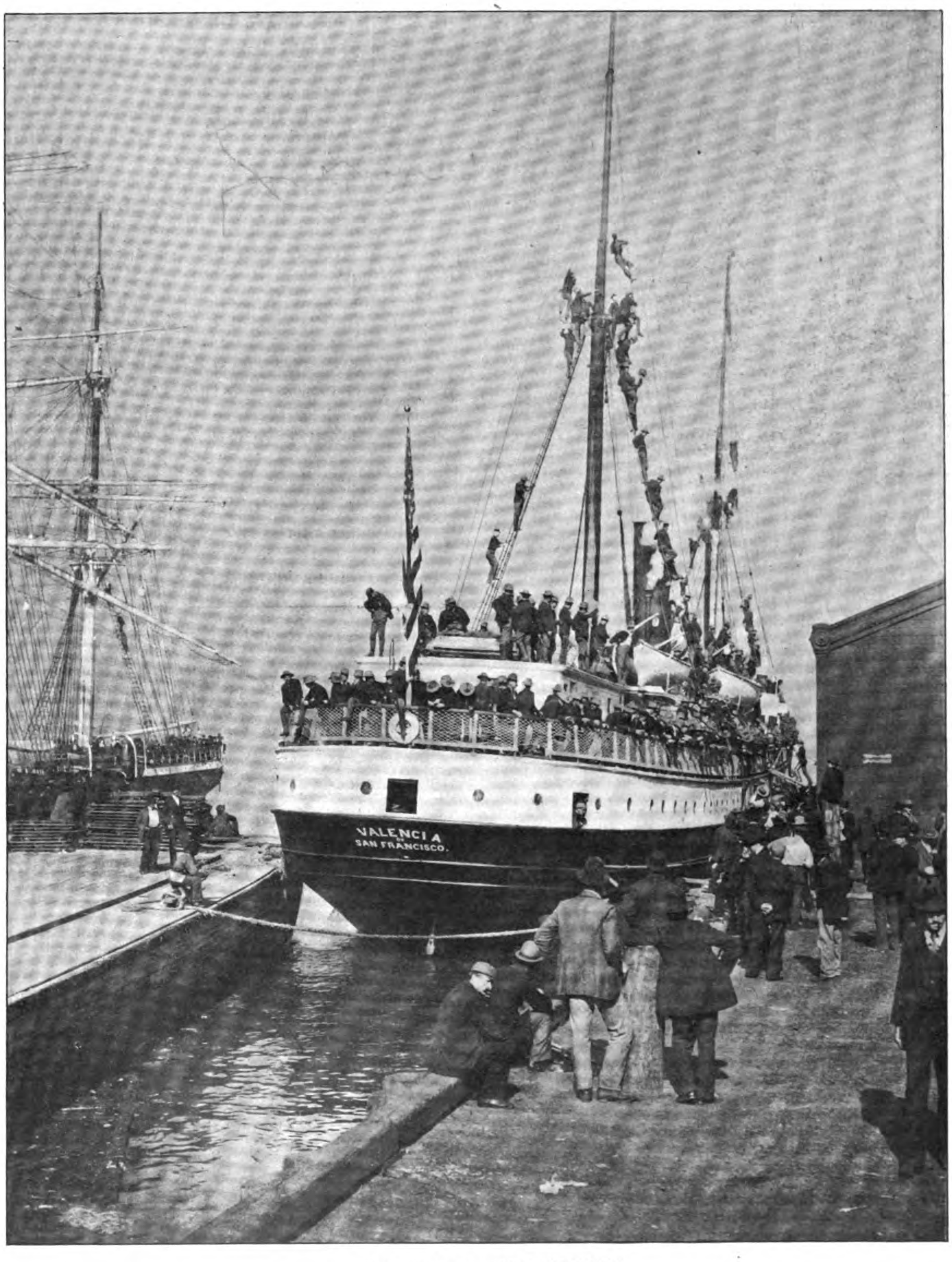
John McKerchey, of Detroit, contractor, has given contract to the Great Lakes Engineering Works for the construction of a rather novel steamer. The order calls for a twin-screw steel boat 169 ft. long over all and 37 ft. beam. She will be operated mostly as a sand sucker but the hull will be constructed so that she can, if needed, carry coal and lumber. She will be equipped with two steeple compound engines and a Scotch boiler. Delivery is promised by May 15.

In the variety of its operations, the Cleveland Cliffs Iron Co. takes second place to the United States Steel Corporation in Lake Superior ores. For the season of 1906 the Cleveland Cliffs Iron Co. has more orders on its books for ore than it has ever before mined, notwithstanding the fact that it shipped 2,014,735 tons of ore in 1905. The company is now preparing for a maximum output in 1906. Extensive improvements are under way in a number of mines. At the Cliffs shaft at Ishpeming a large electric underground haulage plant is being installed; at the Crosby on the Mesabi a 200,000 yard contract for stripping has been given to the Roberts-Kingston Co. and an underground haulage plant is also being installed.

L. W. Powell, the general manager of the Oliver Iron Mining Co., who has resigned to superintend the Cole group of copper mines at Bisbee, Arizona, was given a banquet at Duluth recently. Mr. W. J. Olcott, presided as toastmaster. The speakers were: Chester A. Congdon, Joseph B. Colton, J. H. Hearding, John Uno Sebenius, W. H. Johnston and W. A. McGonagle. Others present were: Charles Trezona, general superintendent of the Pioneer, Chandler and Minnesota mines, of Ely; M. S. Hawkins, general superintendent of the Mountain Iron and Virginia mines of Mountain Iron; R. R. Trezona, general superintendent of the Fayal mine of Eveleth; J. H. McLean, general superintendent; D. E. Sullivan, assistant general superintendent of the Gogebic range mines; W. H. Johnston, general superintendent of the Marquette range mines; O. C. Davidson, general superintendent of the Menominee range mines; W. M. Jeffrey, auditor; George D. Swift, assistant secretary; R. E. Mace, purchasing agent of the Oliver Iron Mining Co.; F. E. House, president of the Duluth & Iron Range road; W. W. Croze, superintendent of mineral lands; H. J. Wessinger, chief engineer; J. L. Mullen, assistant auditor; F. D. Adams, assistant general solicitor and W. N. Merriam, geologist of the Oliver Iron Mining Co.; A. F. Harvey, assistant general manager of the Pittsburg Steamship Co.; John C. Greenway, general superintendent of mines on western Mesabi range; Dr. Charles G. Shipman, mine physician at Ely and Werner Presentin, tax commissioner of the Oliver Iron Mining Co.

LOSS OF THE VALENCIA.

The steamer Valencia, belonging to the fleet of the Pacific Coast Steamship Co., was wrecked near Cape Beale on the Vancouver Island coast on the morning of Jan. 23 with a heavy loss of life, greater than that of any disaster that has occurred near Victoria since the collision of the Orpheus with the Pacific. The Valencia sailed from San Francisco on her second trip to Victoria replacing the disabled steamer City of Puebla. The weather continued thick from the beginning and the steamer had to be navigated by dead reckoning. Nearing the entrance to the straits the weather was very thick and the officers thought they were in the vicinity of Umatilla Reef lightship. Unable to make out their position the lead line was resorted to but almost immediately thereafter the steamer struck the reef. The steamer was backed into deep water but began filling immediately and Capt. Johnston thereupon beached her. Tons of water swept over the steamer in the heavy sea that was running and scores of the passengers were drowned in endeavoring to launch the life boats. Vessels that were sent to the rescue were unable to render any real assistance for many hours.

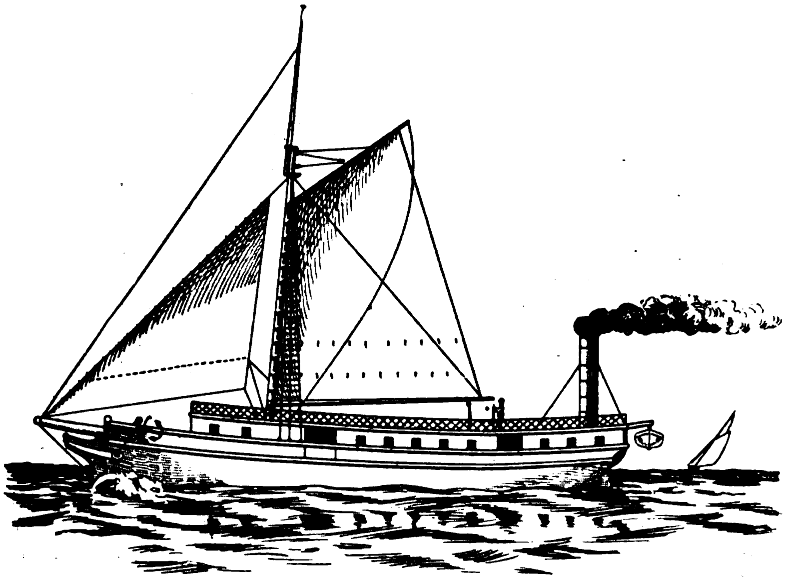


THE LOST STEAMER VALENCIA.

Pursuant to a resolution adopted at its annual meeting, the Lake Carriers' Association will hold no conference with the Lake Pilots' Protective Association.

DEATH OF STEPHEN R. KIRBY.

Stephen Russell Kirby, one of the grand old men of the great lakes, died at his home in New York city this week at the age of eighty-two years. Mr. Kirby had been identified with lake trade from the early days, practically from the beginning of steam navigation on the lakes. He

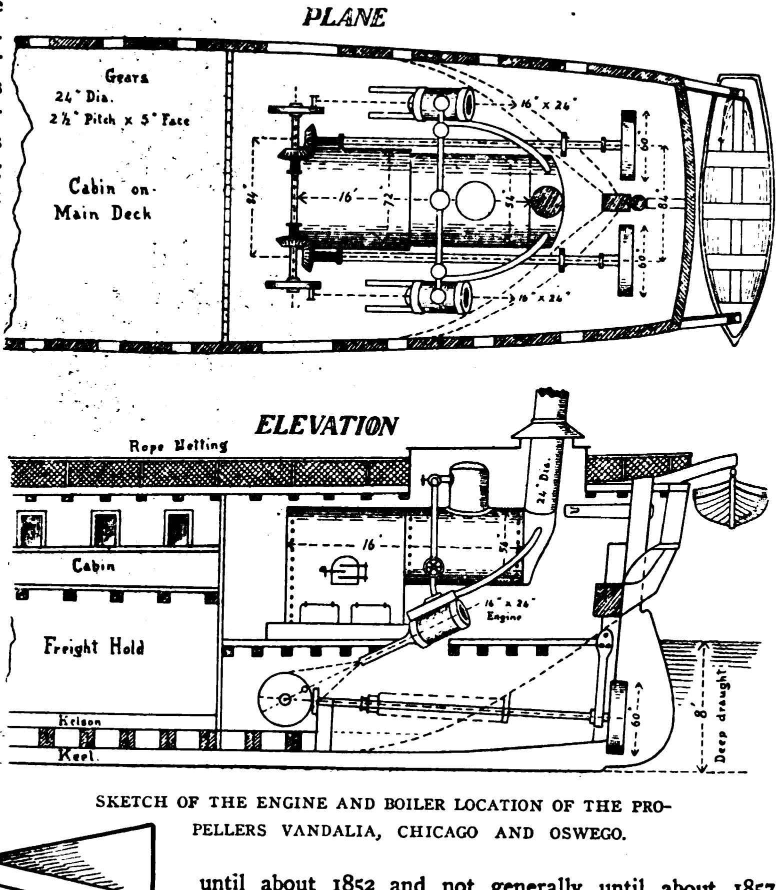


Vandalia, 1839-40. Dimensions 95 ft. over all, 80 ft. keel, 19½ ft. beam, 10 ft. molded depth. She was the first screw boat built on the great lakes. She was first intended for a small vessel, but altered to a screw boat before she went into commission—in fact before she was launched.

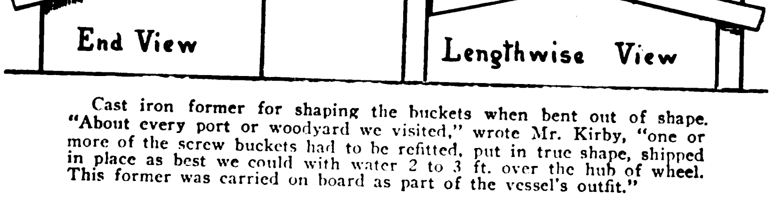
was first of all a sailor and later a ship builder. He was a member of the firm of Campbell, Owen & Co. from which developed the Detroit Dry Dock Co. After leaving the lakes Mr. Kirby was inspector of hulls at New York and later was the constructing engineer of the mammoth elevator at Newport News, Va. His son, Frank E. Kirby, is a famous ship builder, having designed the leading passenger steamers on the great lakes.

In 1901, Mr. Stephen R. Kirby wrote a brief account of his early life on the lakes for the MARINE REVIEW in the form of two letters, one devoted to the pioneer screw boats on the lakes and the other to the brig Ramsey Crooks, in which he also sailed. The sketch of these vessels published herewith was drawn by Mr. Kirby when he was past seventy-eight years old. His first letter is as follows:

"Thinking that perhaps you would like to see and hear something about the pioneer screw boats on the lakes, I enclose you some pen sketches of the very first boats which were fitted out with screws. I resided in Oswego when these hookers, as the boys called them, were built, and afterwards during the seasons of 1845 and 1846 was chief mate of the Chicago. We traded between Cleveland and the Sault. This was during the excitement caused by the discovery of copper on Lake Superior. By the way, it was in the fall of 1846 that we chartered the Chicago to the Indian payment commission who were paying the Indians at the Sault, to take them to Mackinaw and thence to Green Bay. While on the voyage or when we were on our way back, we were signaled when off the mouth of the Menominee river, which is the boundary between Wisconsin and Michigan. We ran on shore and found that a party of government surveyors wanted passage to Mackinaw or to Milwaukee. We concluded to take them to Milwaukee, where we thought a good freight could be obtained for Buffalo. The party consisted of William A. Burt, and eighteen men. They had been all the season surveying the boundary line and also running preliminary lines necessary to survey the upper peninsula of Michigan. They reported that iron ore was abundant all along the south shore of Lake Superior, causing great disturbance to the compass needles (hence the discovery). After reaching Milwaukee we fixed up our ship and took on board 4,000 bu. of wheat at 24 cents a bu., plus twenty tons of pig lead and a dozen casks of potash, at equally good prices. We had a good run to Buffalo and back to Cleveland for winter quarters. This ended my having anything more to do with the pioneer screw ships. These ships burned wood for fuel, twenty-five to thirty cords being taken on board every thirty-six to forty hours. It was piled on the upper deck from end to end of the ship, the watch on deck passing it down to the fireman from time to time during the watch. This occupied them nearly all the time on deck—one man steering and all the rest amusing themselves handling wood. No coal was used in those days. In fact coal was not used



SKETCH OF THE ENGINE AND BOILER LOCATION OF THE PROPELLERS VANDALIA, CHICAGO AND OSWEGO.

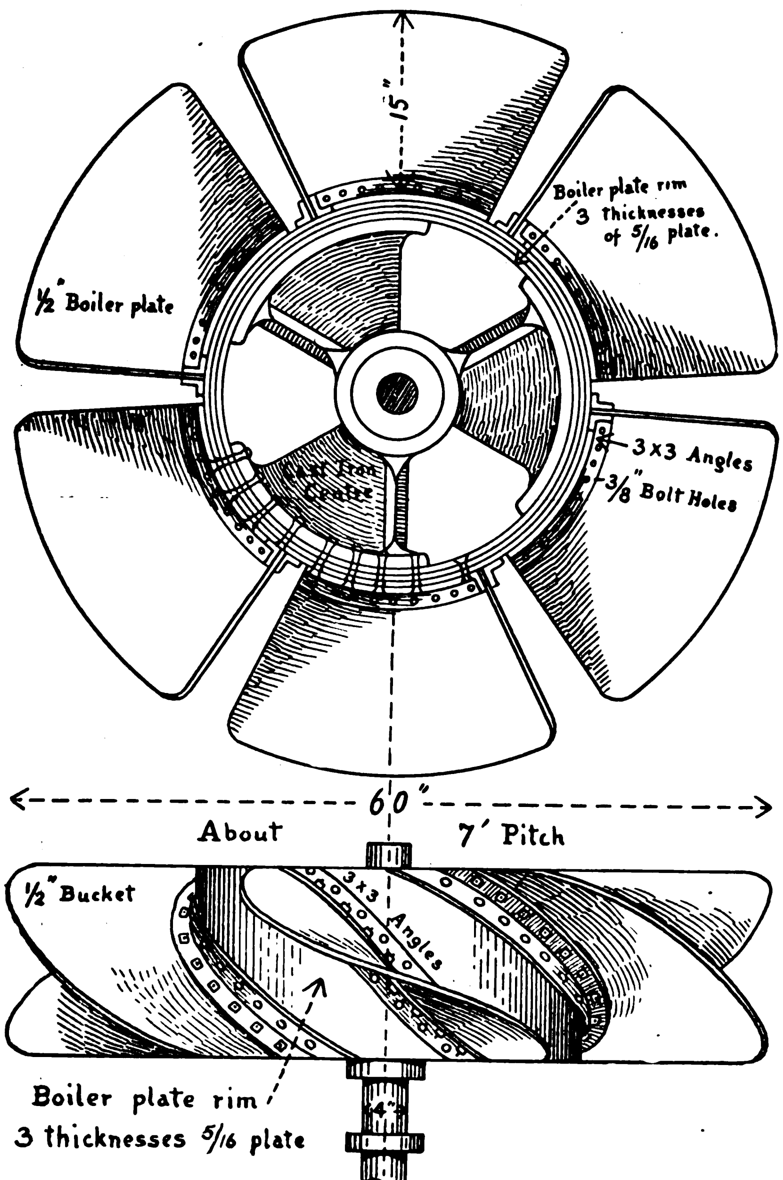


Cast iron former for shaping the buckets when bent out of shape. "About every port or woodyard we visited," wrote Mr. Kirby, "one or more of the screw buckets had to be refitted, put in true shape, shipped in place as best we could with water 2 to 3 ft. over the hub of wheel. This former was carried on board as part of the vessel's outfit."

until about 1852 and not generally until about 1857 or 1858."

The second of Mr. Kirby's letters is devoted to a description of the brig Ramsey Crooks of the American Fur Co., which was built in 1836, and also the other vessels contemporary with it. Describing the vessel, Mr. Kirby says:

"I was two years on this ship, 1843 and 1844, with



PLAN OF SCREWS OF THE VANDALIA, CHICAGO AND OSWEGO, 1839-40-41.

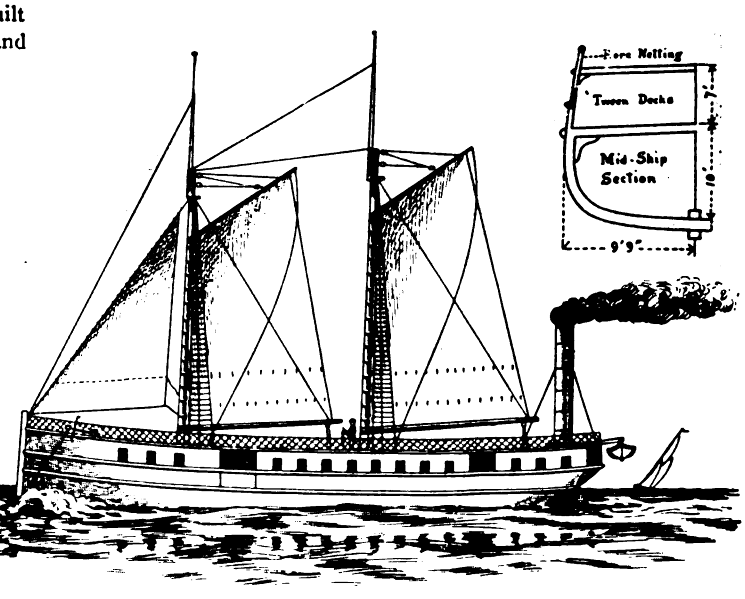
Capt. John and Capt. Orlando Woods. This ship was built in 1836, specially for the fur company's own business, and traded between Detroit and the Sault until 1850 when she was sold. The fur company dissolved after Astor's death in 1848. The ship was first commanded by Capt. Ben Stannard. The chief mate was Chris Goulder, who, I think, was the father of Harvey D. Goulder, of Cleveland, and John Wood was third mate. In the fall of 1837 or 1838 the Ramsey Crooks was caught in the ice 10 or 12 miles off Bar Point at the mouth of Detroit river and laid outside all winter. She usually made a Buffalo trip in the fall before going into winter quarters at Detroit. She was an extra fine and very fast sailer. She was fitted for passengers in splendid style, having a ladies' cabin specially designed. The cabin was entirely on deck, as shown, with caboose separate. She was about 100 ft. by 28 ft. by 9 ft., and of 247 tons measurement. The Crooks, after being sold, was lengthened 25 ft. and was in commission up to about 1860. I do not recollect how she ended her days. The top sail schooner John Jacob Astor on Lake Superior was built about the same time as the Crooks. They formed the line, Detroit to La Pointe and other places on Lake Superior. The Astor was fitted with quarter boats. She had to do all the work from her anchors—no wharves or piers to land stuff directly from ships existing in those days. The Astor was also fitted for passengers, the same as the Crooks. She was lost at Copper Harbor in the fall of 1845. We had previously carried up timber for a new vessel on Lake Superior to help the Astor, and men to build her, in 1844. This vessel was about the size of the Astor with fore-and-aft rig. She was launched in the spring of 1845 and named the Napoleon. She was commanded by Capt. John Stewart. Two years afterward she was converted into a propeller. She ended her days on St. Clair flats doing lighterage work to help vessels over the shoals in the north channel of St. Clair river. No government work had been done to help the navigator."

OBITUARY.

Capt. Charles Gale, who was undoubtedly the oldest vessel master on the lakes died at the House of Refuge, Sarnia, on Jan. 18 at the age of eighty-nine years. Capt. Gale was born in Chicago and began sailing at a very early age. The first vessel in which he was interested was the Comet, a Canadian sailing craft which he purchased jointly with Capt. Joseph Fox about 1841. In later years he built and sailed for Handy & Warner, of Cleveland, vessels that were among the best of the lake fleet, notably the John G. Deshler and John B. Wright both of which crossed the Atlantic under his command. He later sailed vessels belonging to the Northwestern Transportation Co.'s fleet which were the forerunners of the wooden type of ore carriers. During his later years Capt. Gale wrote for a number of the marine journals and his recollections of early days made most interesting reading.

SHIFTING COAL BOATS.

The steamer F. B. Squire, owned by Charles O. Jenkins, of Cleveland, made the run this week from Buffalo to Cleveland under command of Capt. Wm. Smith. She had a full crew aboard and made the trip in fourteen hours under her own steam. She will be dry docked for minor repairs and will take on a cargo of coal next week. This is the second boat to be shifted from Buffalo, the John Stanton



Twin screw boats Chicago and Oswego. Built in Oswego, N. Y., 1840-41. Dimensions, 95 ft. over all; 19½ ft. beam; 10 ft. molded depth; capacity 150 tons on 8 ft. draught; speed 7 knots in calm weather. At the time these ships were built the Welland canal locks were 100 ft. long, 20 ft. wide and 8 ft. deep on sills.

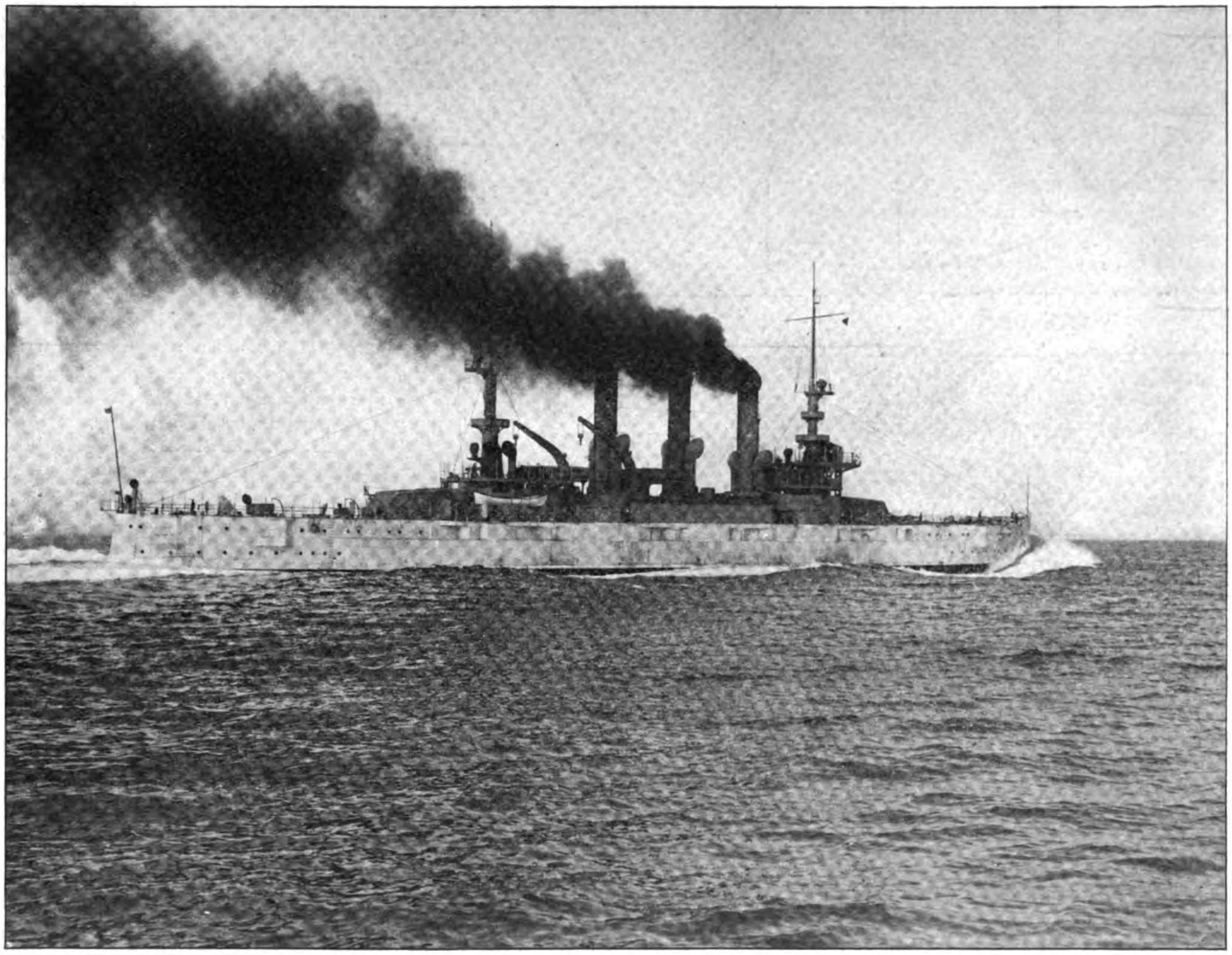
being the first, and if the weather continues favorable other boats will be shifted. Most of the vessels are loading coal at 15 cents over the opening rate, though some business has been done at 10 cents. There will be a great deal of coal afloat by the time navigation opens.

TRIAL OF BATTLESHIP LOUISIANA.

On her official contract speed trials, held off the New England coast on Dec. 13 and 14, the 16,000-ton battleship Louisiana, built by the Newport News Ship Building & Dry Dock Co., Newport News, Va., and the first warship of her class to be made ready for trial, measured up to every contract requirement and set a pace for her sister-ship, the Connecticut, now under construction at the New York navy yard, that will be difficult to exceed.

The Louisiana arrived at Rockland, Me., on the afternoon of Dec. 12., after a stormy passage up the coast, having encountered rough weather from the time she passed out of the Virginia capes until she dropped anchor in the Maine harbor, where the one-knot course is laid off for screw standardization. On the run up, the ship's seaworthiness was put to the test. The sea was rough, hurricane winds prevailed and she ran through rain and snow storms, all of which she weathered with ease.

Immediately after arriving at Rockland preparations were commenced for the standardization runs scheduled to occur the following morning over the course in Penobscot Bay. At 8 o'clock on the 13th the Louisiana started on the standardization run, which she finished at 11:30 a. m., after having gone over the course twelve times at various speeds. From the first it was evident that she was a speedy ship. She started at high speed and gradually reduced the revolutions of her engines in order to enable the naval trial board to plot a speed curve from which to ascertain the number of revolutions required per minute to drive the vessel at her contract speed of 18 knots an hour. The Louisiana made one dash over the course at the rate of 18.922 knots, while the average for the four high-speed runs was 18.61. The maximum number of revolutions developed during this test was 126.32 and this was accomplished without any undue forcing, the ordinary run-of-mine New River coal being used. In every respect the machinery worked perfectly and the engines were kept under complete control, running smoothly and with the nicety of clock work and causing very little vibration. Her boilers, which are of the Babcock and Wilcox marine water-tube type, steamed freely. At no time during the run was the maximum air pressure allowed reached. From the data gathered during the runs the trial board reckoned that a mean of both engines of 119.1 revolutions per minute was requisite to a true speed of 18 knots.



THE BATTLESHIP LOUISIANA ON HER TRIAL.

The standardization trial was highly gratifying to the builders as well as to the naval trial board. Among the interested spectators on board were Rear-Admiral W. L. Capps, chief of the bureau of construction and repair; Naval Constructor David W. Taylor, who designed the Louisiana class, and Capt. A. R. Couden, who will command the new battleship when she is placed in commission. The trial was

run under the direction of Mr. W. A. Post, general manager of the Newport News company. After the standardization trial was completed the anchor gear was tested, the anchors being let go in thirty fathoms of water. This test was entirely satisfactory.

On the morning of the 14th the Louisiana started on her four-hour endurance speed trial in the open sea, running from Monhegan Light in the direction of Boston Light. As the trial board had previously determined that 119.1 revolutions per minute would give the contract speed of 18 knots, it was obvious that the battleship would establish a fast record. It was only a question of margin. From the beginning she struck her pace and kept it up. The engines worked perfectly and the boilers again displayed splendid steaming qualities, developing 20,906 collective H. P., while the designed horsepower was 16,500. There was no grueling grind to get the speed, for that was not necessary. She can make 18 knots any time. The average speed for the four-hour run was 18.823 knots, the average turns of the propellers being 127.68.

At the conclusion of the run and while the ship was still under forced draft, the steering gear was tested by the naval board. The helm was put hard-a-port in eleven seconds and then shifted to hard-a-starboard in eighteen seconds. On completing this test the helm was put amidships and the vessel put through reversing tests, all of which were satisfactory.

The trial board, of which Capt. J. H. Dayton, U. S. N., was president, left the vessel at Boston Light, and the Louisiana, with a broom lashed to her masthead, proceeded down the coast to Newport News, arriving there on the morning of the 16th, after a rough trip. The finishing touches are being put on and she will be ready to go into commission in the near future.

The leading particulars of the Louisiana are as follows: Length on load waterline, 450 ft.; beam, extreme to outside of plating, 76 ft. 8 in.; draught on normal displacement of 16,000 tons, 24 ft. 6 in.; designed indicated horsepower, 16,500. The Louisiana is propelled by two sets of triple-expansion engines with cylinders 32½, 53 and two 61-in. diameters by 48-in. stroke of piston. Her twelve boilers are of the Babcock & Wilcox type placed in six watertight compartments and supplying steam at 265 lb. pressure. The total grate surface of the twelve boilers is 1,100 sq. ft. and the total heating surface is 52,750 sq. ft. Her hull is protected by a complete waterline belt of armor 9 ft. 3 in. wide amidships and stepped down at the ends. In wake of machinery space the armor is 11 in. thick at the top, tapering to 9 in. at the bottom.

Her main battery consists of four 12-in. breech loading rifles mounted in two turrets, one forward and one aft; eight 8-in. breech loading rifles mounted in four side turrets Her secondary battery consists of twenty 3-in. 14 pounder rapid-fire guns, 50 caliber in length, twelve 3-pounder semi-automatic guns, six 1-pounder automatic guns, two 1-pounder semi-automatic guns, two 3-in. field pieces, two machine guns of .30 caliber and six automatic guns of .30 caliber. She also carries four 21-in. submerged torpedo tubes.

DECLARES FOR THE OPEN SHOP.

THE FOLLOWING NOTICE WHICH HAS BEEN POSTED IN THE PLANT OF THE BUFFALO DRY DOCK CO., REQUIRES NO EXPLANATION.

To whom it may concern:—

This is a declaration that the yard and plant of this company is what is commonly known as an Open Shop, where employment is offered to all (subject to the rules and regulations of the management) without distinction as to color, creed, nationality or membership of organizations, the main requirements being a faithful performance of duty, and willingness to give a fair day's work for a fair day's pay.

BUFFALO DRY DOCK CO., Buffalo, Jan. 22, 1906.

THE WORLD'S SHIP BUILDING OUTPUT.

	1904.	1905.
British Private Yards	1,348,533	1,698,152
British Royal Dock Yards	57,100	46,250
Totals	1,405,633	1,744,402

FOREIGN AND COLONIAL.

	1904. Tons.	1905. Tons
United States	324,175	368,775
Germany	271,942	312,400
France	143,390	101,073
Holland	84,060	92,522
Norway and Sweden	62,510	64,823
Italy	60,969	58,193
Japan	34,016	47,458
Austria-Hungary	28,098	27,675
Denmark	13,836	17,124
China	12,702	6,429
Belgium	8,457	2,034
Russia	5,449	25,985
Spain	1,144	2,861
Greece	35	....
British Colonies	25,086	10,610
Total, Foreign and Colonial	1,075,869	1,137,962
Total, United Kingdom	1,405,633	1,698,152
Total Royal Dock Yards (Displacement Tonnage)	....	46,250
The World's Output	2,481,502	2,882,364

British Increase, 24 per cent.
Foreign Increase, 5.7 per cent.
British Share of the World's Output, 60.5 per cent.

THE ASSOCIATION OF PASSENGER STEAMBOAT LINES.

At the annual meeting of the Association of Passenger Steamboat Lines held at Prince George Hotel, New York, Jan. 18 and 19, the following officers were elected: President, Geo. A. White, Hudson River Day Line, New York; Secretary-Treasurer, W. F. Herman, Cleveland Transit Co., Cleveland; Executive Committee, T. F. Newman, Cleveland & Buffalo Transit Co., Cleveland; H. W. Thorp, Goodrich Line, Chicago; J. C. Evans, Erie & Western Trans. Co, Buffalo; E. C. Reynolds, Pere Marquette Line Strs., Milwaukee, Wis.; C. M. Englis, Citizens Steamboat Co., New York; C. J. Smith, Richelieu & Ontario Nav. Co., Montreal; B. W. Parker, White Star Line, Detroit, Mich.

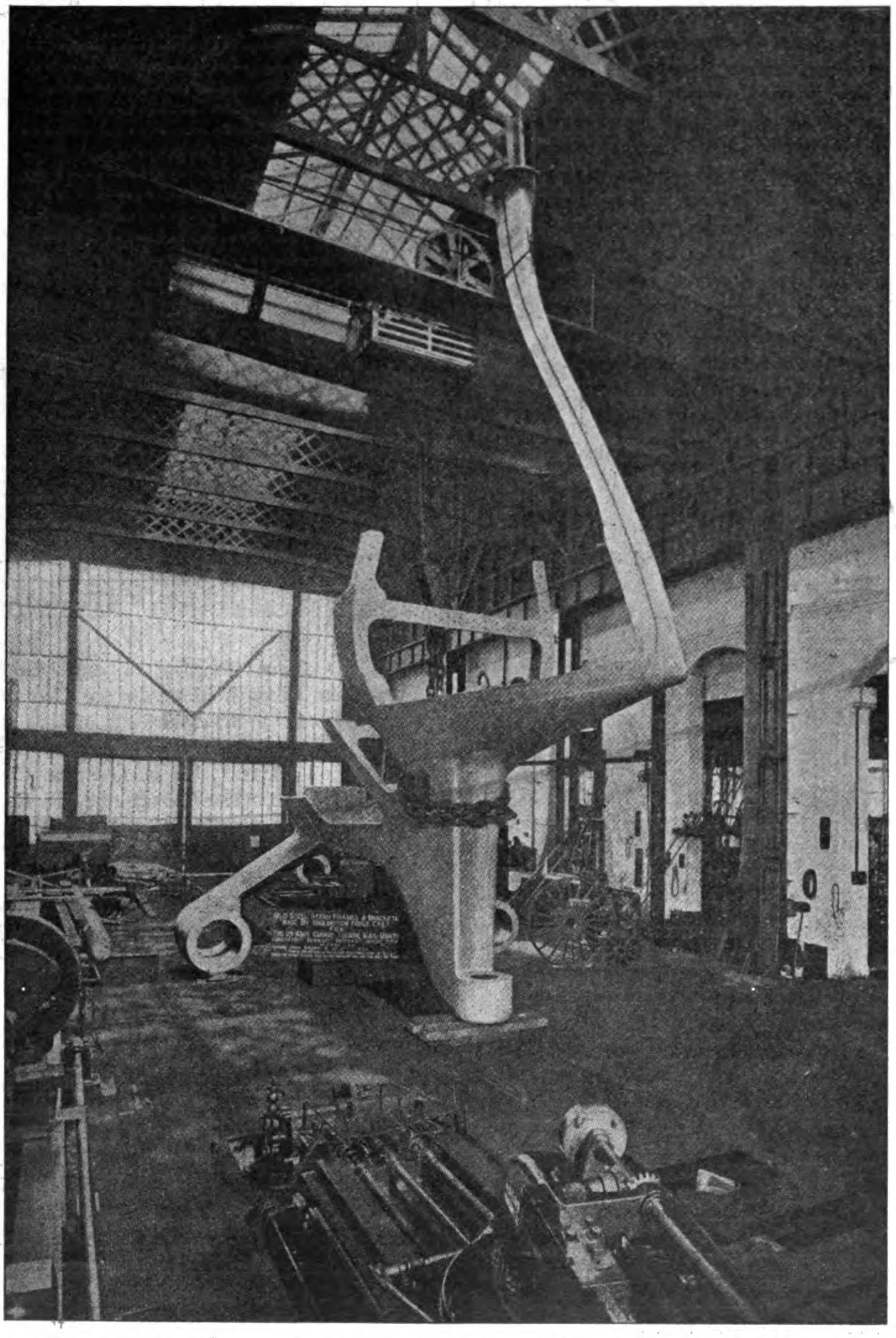
The freight steamer Trojan of the Boston & Philadelphia Steamship Co.'s fleet was sunk in a collision with the Ocean Line steamer Nacooche during a dense fog off Vineyard Sound lighthouse. The Nacooche rescued the officers and crew of the Trojan. The Trojan was formerly the steamer Orion of the Boston Tow Boat Co.'s fleet. Some months ago she was purchased by the Boston & Philadelphia Steamship Co., which expended a large amount of money in rebuilding her. The Trojan was rebuilt by the Harlan & Hollingsworth Co., Wilmington, Del. in 1868 and was 260 ft. keel, 38 ft. beam and 23 ft. deep

The Louisiana Railway & Navigation Co., of New Orleans, La., has given contracts to Howard's Ship Yard at Jeffersonville, Ind. for two new transfer barges and two new tow barges. The barges will be of steel and will be 245 ft. long, 37 ft. beam and 7½ ft. hold. One of these barges will be used for carrying passenger cars and the other for freight cars. One of the boats, to be named the Wm. Edinborn. will be made of wood and the other, not yet named, will be built of steel. They are both to be 145 ft. long, 31 ft. beam and 5 ft. deep.

Mr. George Q. Weldin has been appointed superintending engineer for the North West Steamship Co.

A RECORD SET OF STEEL CASTINGS.

Progress in naval architecture and marine engineering depends more than is generally realized on the skill and resource of the steel manufacturer. For instance, the present-day armored cruiser would never have been evolved had it not been for the improvements in the manufacture of armor plates. It frequently happens, however, that the designers of ships and engines have to point the way and ask the steel manufacturer to attempt the apparently impossible. The castings for the stern of the new Cunarders, now building at Messrs. John Brown, Clydebank, and Messrs. Swan & Hunter's, Wallsend-on-Tyne, are fine examples of what can be done in the manufacture of steel castings. A special shape was necessary, because the rudder had to be wholly below water, so that it and the steering gear might be protected. The main piece of the stern frame weighs 47 tons, and consists of a massive portion to take the weight of the rudder, brackets to lay hold of the steel structure of the ship at the stern and a long slighter portion to form the contour. The after-shaft brackets were cast singly, and each weighs 22½ tons. The forward brackets are also independent and each weighs 24 tons. Altogether the total weight of the rudder, stern frame and the four brackets will be approximately 220 tons. The height from the bottom of the rudder blade to the top of the stern casting is 55 ft. It will be remembered that these ships are to have four screws, and it is not too much to say that they could not have been built had not firms like the Darlington Forge Co. brought to perfection the manufacture of the steel casting.



CAST STEEL STERN FRAME AND SHAFT BRACKETS FOR FAST CUNARD TURBINE MAIL STEAMER.
[MADE BY THE DARLINGTON FORGE CO., LTD., OCTOBER, 1905.]

For the conveyance of this gigantic stern frame elaborate arrangements were carried out by the North-Eastern Railway Co. Owing to its exceptional size it was found impossible to carry the article by railway to the Tyne, and arrangements were consequently made to ship it at Messrs. Richardson, Westgarth & Co.'s shear-legs at Middlesbrough by special steamer. Although the stern post was loaded upon a specially designed 50-ton car it exceeded the ordinary railway loading gauge, and for the journey from Darlington to Middlesbrough both sets of rails on either side of the "stern frame special" were put into use. Owing to the great weight of the freight the train did not exceed a speed of three miles an hour. It was necessary to make some structural alterations to one of the station platforms, and to remove some signaling posts before the load could reach its destination in safety. In order that it might enter the siding leading to the shear-legs two mammoth travelling cranes accompanied the train slightly to shift the load at a critical point.

To afford an illustration of the dimensions of the stern frame, it may be stated that the distance from rail level to top of load was 13 ft., and the extreme width 15 ft. 6 in. On the 6-ft. side, the wing of the frame overlapped no less than 8 ft. 6 in., and on the abutment side 3 ft. 6 in. But perhaps the best idea of the size of this stupendous casting can be got from our illustration. It will be seen that the frame literally towers to the roof. One not acquainted with its purpose would find difficulty in recognizing its use, and no doubt many landsmen would be at a loss to say what it is.

The Wm. Skinner & Sons Ship Building & Dry Dock Co., Baltimore, Md., has received an order from the Western Maryland Railroad Co. for a mammoth car float for service in Baltimore harbor to be capable of carrying ten freight cars. The float will be 220 ft. long, 34 ft. beam and 8½ ft. deep. The company will also build for the Baltimore & Ohio Railroad, five covered and one open cargo lighter for service in New York harbor. The lighters are to be 80 ft. long, 28 ft. beam and 8 ft. deep.

HELM AND ENGINE-SHAFT INDICATOR FOR SHIPS.

To guard against the effects of possible misunderstanding or remissness on the part of the engine room staff, it has been usual for some time to equip all vessels of the British navy with instruments to indicate to the officers in charge that his instructions have been carried out in the engine room. An exact knowledge of what each set of engines is doing, and what position the rudder is in, before the conditions are made evident by the behavior of the ship, will give him far more control over the movements of the vessel, and in maneuvering or entering a dock may often avert a disaster. Devices for this purpose, as used in the navy, are generally electrical, and though they act well enough, their cost is,

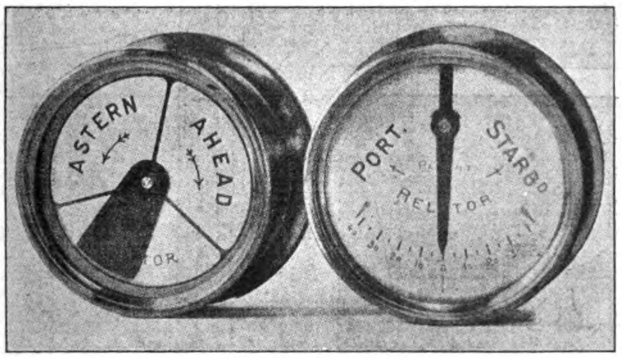


FIG. I.

as a rule, too great for them to be fitted to the merchant marine, where their presence would be equally beneficial. A method of transmitting the required signals by pneumatic means has now been introduced into the Danish navy, and, being considerably cheaper than the electrical devices, it is hoped that it will become a standard part of the navigating apparatus of vessels of the merchant service. The apparatus is arranged for two distinct purposes: to indicate the direc-

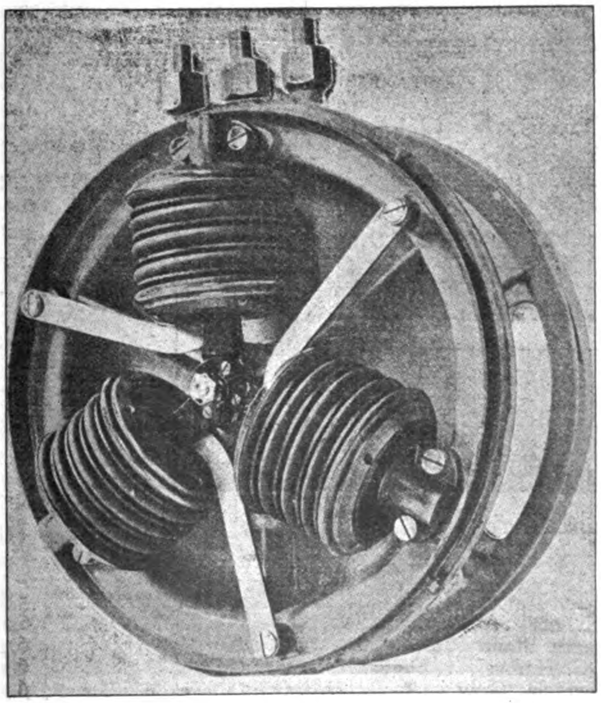


FIG. 2.

tion and approximately the speed of rotation of the engines, and to indicate the position of the rudder. The engine indicator, shown on the left-hand side of Fig. 1, is a cylindrical brass instrument, 7 in. in diameter, with a glass front, through which can be seen a broad black needle which rotates over the dial. Its direction and speed of rotation correspond to those of the propeller shaft. On the right of Fig. 1 is seen the rudder indicator, which is similar in appearance, except that the needle is a narrow pointer and moves over a scale graduated for 40 degrees to port and starboard of its central zero position. The internal mechanism of these instruments is identical with that of their corresponding transmitting instruments, and will be understood from the description of Fig. 2, which is the transmitter for the revolution indicator. This transmitter is worked by a wheel at the back of the case, which is belted in the propeller-shaft. The shaft of the wheel carries a disc-crank inside the case, the crank-pin being adjustable for throw along a slot in the face of the disc. Three cylindrical bellows, with india-rubber sides and metal ends, are fixed radially to the inner rim of the case, and are all operated from the crank-pin by connecting-rods jointed in the bottom of the recessed metallic plates forming the free ends of the bellows. To each of the gudgeon-pins is also jointed a curved lever, the other end of which is jointed to the case, so as to constrain the small end of the connecting-rod to move in approximately a straight line. In the fixed end of each bellows is a port communicating with one of the three pipe-nipples seen projecting from the case. These nipples are connected by three pipes to the corresponding nipples on the indicating instrument, so that the bellows of the latter are operated by alternating puffs of air set in motion by the bellows of the transmitter. Having three bellows in each instrument eliminates dead center, so that the indicator will start from any position. The transmitting system is, in fact, analogous in many respects to a three-phase electrical transmission.

The rudder-transmitter is geared up so that its crank-pin makes a good many revolutions for a small angular motion of the rudder, and the indicator is, of course, geared down to a corresponding degree. This makes the position of the indicating needle a much more exact copy of the rudder than might otherwise be the case. It need hardly be pointed out that the instrument last described may be used as a perfectly efficient substitute for the ordinary engine room telegraph, if the dial of the indicator is painted with the usual indications, such as "half speed ahead," "full speed astern," "stop," etc.

The apparatus is being made in England by Messrs. Evershed & Vignoles, of Acton lane, Chiswick.

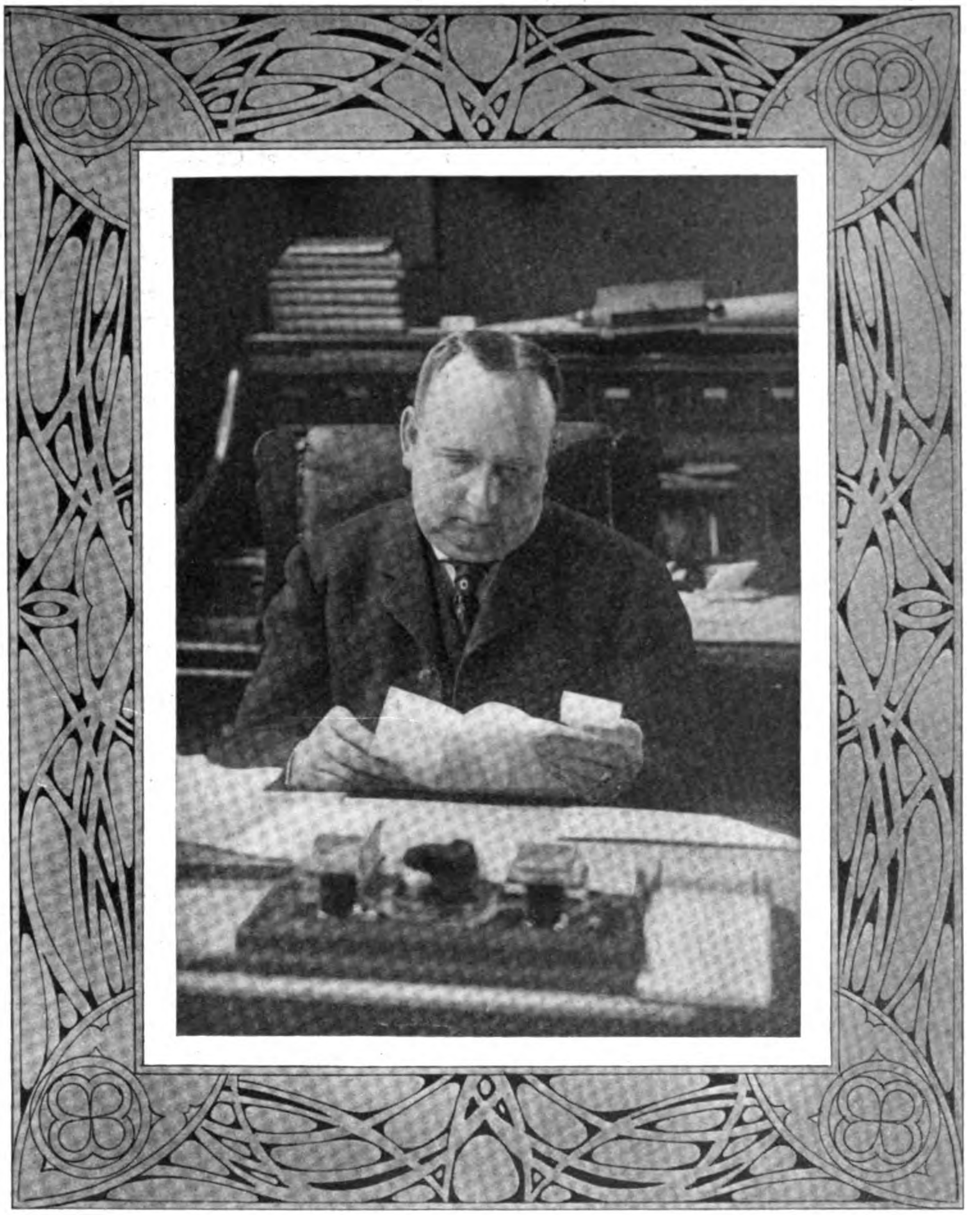
A NEW GASKET.

For mechanical uses the ever increasing steam, water, air and gas pressures call for improvements in joint connections to withstand the highest service and has been the subject of much thought and study by experts especially on the subject of gaskets. Such joints must be absolutely air, water and gas tight under any pressure. They must be easily and quickly made and taken apart. The joint should be as thin as possible. The joint should not leak when cold or hot or from unequal expansion. The gasket should not cause electrolysis. Therefore, on iron pipes a gasket composed of iron should make the best joint. The attention of engineers is called to a corrugated iron gasket coated thinly with a special iron cement that appears to fill these requirements, and is said to make the thinnest and strongest gasket in use and the nearest to a ground-joint. It is as durable as the pipes it connects as well as one of the cheapest gaskets. The active principal of a slight expansion found in these gaskets when made up makes the connections tight and strong, which is not obtained in inert or dead material commonly used for such purposes. Joints made with this packing are ready for use as soon as completed and can be taken apart when necessary and the same gasket used again. These gaskets will keep indefinitely. They are manufactured by the Smooth-On Mfg. Co., Jersey City, N. J.

SHIP BUILDING OUTPUT OF THREE YARDS.

To the majority of Europeans the great lakes of North America are only little blue patches on the map of the world. It would therefore be very surprising to them, should the intelligence ever reach them, that a single ship building company on the great lakes last year put more vessels into the water than any of the famous ship yards of Europe.

The American Ship Building Co. of Cleveland, last year launched twenty steamers of 117,482 gross tons register, against twenty steamers of 86,632 tons gross register by Wm. Doxford & Sons, Sunderland, Eng., and nine steamers of 85,287 tons gross register by the great yard of Harland & Wolff, Belfast, Ireland. Mr. James C. Wallace, of Cleveland, is therefore justly entitled to be credited with being the world's greatest ship builder in point of tonnage during 1905. Mr. Wallace, who is not yet forty years old, has in a very few years reached the presidency of one of the most solid industrial enterprises in the United States and the most productive combination of ship building yards in the world. Roughly speaking the company is capitalized at $15,000,000, half preferred and half common, and its management is so conservative that an abundant reserve is at all times kept available for working capital. It has on its books at present orders for twenty-nine new steamers for delivery during the present year. Since nothing is more illuminating than figures, there is appended herewith the actual record of work done by the three leading ship yards in the world in point of tonnage during 1905.



MR. JAMES C. WALLACE.

The World's Greatest Ship Builder in Point of Tonnage in 1905.

SHIPS LAUNCHED BY AMERICAN SHIP BUILDING CO.

Name of steamer	Description.	Gross tonnage reg
Francis L. Robbins	Bulk freighter	4,222
James C. Wallace	" "	6,684
Philip Minch	Bulk freighter	5,865
Sylvania	" "	6,272
Amasa Stone	" "	6,282
L. C. Hanna	" "	6,356
Elbert H. Gary	" "	6,331
Stephen M. Clement	" "	5,821
Socapa	" "	6,272
Lyman C. Smith	" "	6,200
Wm. E. Corey	" "	6,363
Wm. A. Paine	" "	5,798
Wm. A. Rogers	" "	6,524
Powell Stackhouse	" "	6,171
Henry C. Frick	" "	6,490

Bessemer & Marquette No. 2	"	"	2,514
John Stanton	"	"	6,129
Joseph C. Butler Jr.	"	"	6,588
Pendennis White	"	"	4,800
W. K. Bixby	"	"	5,800
Total			117,482

SHIPS LAUNCHED BY WM. DOXFORD & SONS. LTD., SUNDERLAND.

†Clan Maclean	Steel	4,675
†Wellington	"	5,599
†Torrington	"	5,597
†Queda	"	7,702
†Nordland	"	3,787
†Kiruna	"	1,921
†Querimba	"	7,695
†Gellivare	"	1,921
†Quiloa	"	7,697
†Serbury	"	3,872
†Hatumet	"	4,116
†Grindon Hall	"	3,721
†Pearlmoor	"	4,118
†Belle of England	"	3,876
†Osterland	"	4,133
†Belle of France	"	3,876
†Carthusian	"	4,121
†Komura	"	2,100
†Ryton	"	4,140
†Oxelosund	"	1,956
Total		86,632

SHIPS LAUNCHED BY HARLAND & WOLFF, BELFAST.

Name.	Description.	Gross tons reg.
Aragon	Steel, Twin Screw	9,441
Bologna	" " "	4,603
Amerika	" " "	22,724
Mahronda	Steel, Single Screw	7,630
Slieve Bawn	Steel, Twin Screw	1,148
Herefordshire	" " "	7,183
Nieuw Amsterdam	" " "	17,250
Malakand	Steel, Single Screw	7,654
Manipur	" " "	7,654
Hibernia	H. M. 1st Cl. Battleship (Machinery only.)	
		85,287

THE PITTSBURG STEAMSHIP CO.'S SCHOOL.

The Pittsburg Steamship Co. has established schools at Cleveland, Conneaut and Marine City under the supervision of Capt. J. M. Fields for the instruction of the masters of its vessels in lake navigation generally and with special reference to the working of the compass, its error and correction. The company has fitted up two rooms in the Rockefeller building to resemble an ordinary school room and has equipped the rooms with all instruments needful to the course of instruction intended. In fact, one of the rooms in the equipment reminds one very much of the deck of a ship. Capt. Fields will be assisted in his work at Cleveland by Mr. P. J. Becker. He will also have the assistance of a committee of captains, consisting of John Lowe, S. C. Allen, J. La Framboise and John Noble: At Conneaut, where he will visit on Fridays, he will be assisted by Capt. A. R. Robinson and Capt. C. J. Grant and at Marine City, where he will visit on Saturdays, he will be assisted by Capt. Hugh Reagan and Capt. T. J. Cullen. Capt. Myers Chamberlain and Capt. F. Hoffman, both of St. Clair, and Capt. John Burns, of Port Huron, will also assist in the school at Marine City. It is interesting to note that a part of the work will include the use of the lead line which gives rise to the observation as to whether the constant use of the lead would not have prevented some of the disasters of last fall. The Cleveland school opened on Monday of the present week. The first course will be nautical arithmetic. This will be followed with instruction in correcting courses from true to magnetic and vice versa. Working a day's work will follow. Instruction will be given in the use of the azimuth tables as well as a thorough knowledge of Field's compass corrector by the sun, moon and stars. Instructions will be given in deviation by a distant object and deviation by reciprocal bearings. General instructions will also be given in chart work.

Capt. Fields has fitted up the rooms with every possible device to aid the masters and the working library is unusually complete. This school will continue until the opening of navigation and instruction will be free.

MINNETONKA AND MINNEWASKA SOLD.

The American Ship Building Co. has sold the steel steamers Minnetonka and Minnewaska to Jerome & Hill of San Francisco. The vessels will be taken to Newport News and converted into oil steamers before they leave for the Pacific. These steamers were built by the American Ship Building Co. at its Cleveland yard for salt water service. They were towed in sections through the Canadian canals and put together at Quebec. They are 450 ft. over all, 430 ft. keel, 43 ft. beam and 35 ft. deep and are equipped with triple expansion engines and Scotch boilers. The steamers were owned by the American Navigation Co. and each one made a trip around the Horn to the Pacific coast. Conditions in the over-sea trade, however, were such that they could not be operated at a profit and for two years they lay at their moorings in Brooklyn. The steamers were bid in by the American Ship Building Co. about a year ago. They cost about $450,000 each to build but the price at which they were sold is not given out.

APPOINTMENTS OF MASTERS AND ENGINEERS.

Mr. J. H. Sheadle has announced the following appointments of masters and engineers for the fleets of the Cleveland Cliffs Iron Co., the Presque Isle Transportation Co. and the Hopkins Steamship Co.

Vessel.	Master.	Chief Engineer.
Wm. G. Mather,	J. M. Johnston,	Thomas Durkin.
Peter White,	S. N. Murphy,	E. V. Barry.
Presque Isle,	H. W. Stone,	Wm. Naylon.
Angeline,	T. E. Murray,	Geo. M. Wise.
Centurion,	C. A. Anderson,	A. G. Bohland.
Pontiac,	C. R. Ney,	Jos. Jamieson.
Frontenac,	U. S. Cody,	J. B. Hart.
Andaste,	James Kennedy,	Bernard Henry.
Choctaw,	F. D. Perew,	Thos. J. Rees.
Cadillac,	W. H. Hoffman,	W. B. Rowe.
Falcon,	Robert Gaskin,	Charles Gregory.
Pioneer,	J. A. Stewart,	D. J. O'Brien,
Chattanooga,	M. J. Pidgeon,	
New Steamer, (Building),	S. A. Lyons,	C. H. Menmuir.
New Steamer, (Building),	H. H. Parsons,	E. I. Jenkins.
New Steamer, (Building),	C. E. Sayre,	....

WANT RULES FOR DETROIT RIVER.

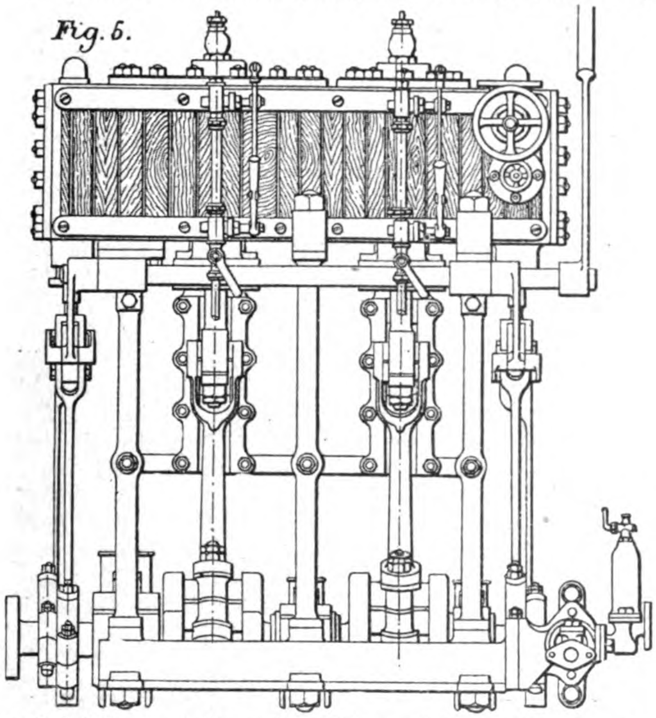
At the annual meeting of the Grand Lodge of the Shipmasters' Association held in Buffalo this week, the following resolution was adopted: "Resolved, that owing to the numerous collisions with loss of life and property occurring in the St. Clair and Detroit rivers, we earnestly recommend that rules similar to those now in use on St. Mary's river be put in force and made obligatory on all vessels using the dredge channels of said waters."

There is building at Bishop's yard, Gloucester, Mass. from designs by McManus, of Boston, a schooner yacht for Mr. L. J. Callanan, of New York. She will be 85 ft. over all and 62 ft. on the water line.

CLAYTON DISINFECTING STEAMER.

Messrs. Forrestt & Co., Wyvenhoe, Essex, England, some time ago built for the British house of the Clayton Fire Extinguishing & Ventilating Co., 11 Broadway, New York,

Fig. 5.



a steel twin-screw fire-extinguishing and disinfecting steamer for service of the government of Mozambique at Delagoa bay. The steamer is 70 ft. 6 in. over all; 67 ft. between perpendiculars; 13 ft. 6 in. molded beam and 5 ft. 6 in. molded

Fig. 6.

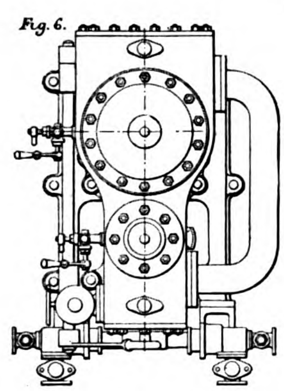


Fig. 7.

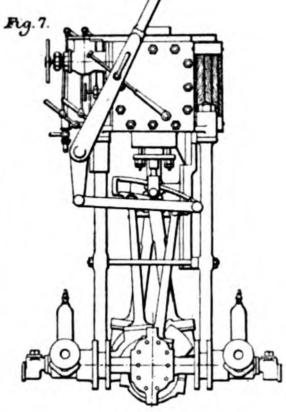


Fig. 8.

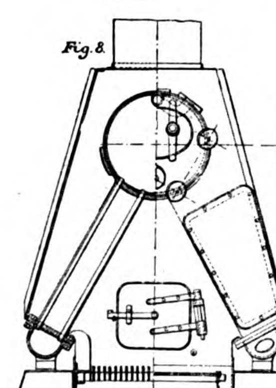
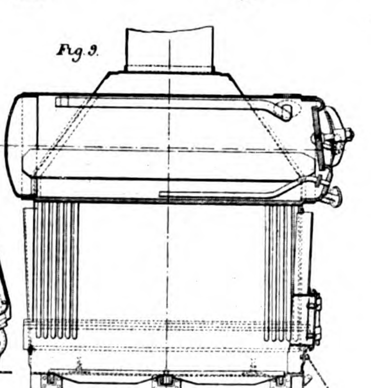


Fig. 9.



depth. The draught when in service with all stores is under 2 ft. 6 in., the vessel trimming level when in this condition. The main deck is plated over amidships and overlaid all fore and aft with teak. A sun deck of galvanized corrugated iron is fitted over the whole length of the vessel, supported on gavanized tube stanchions. Accommodation is provided for a crew of three men in a steel deck house aft. There is a large hold space amidships for storing the hose and gear required for the Clayton disinfecting apparatus and fire pump and containing also bins for the storage of the sulphur used

Fig. 10.

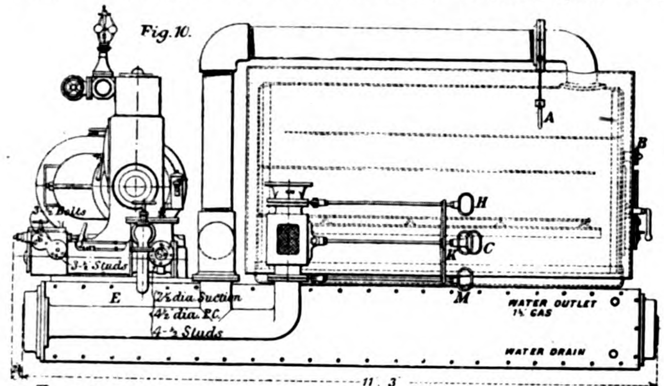
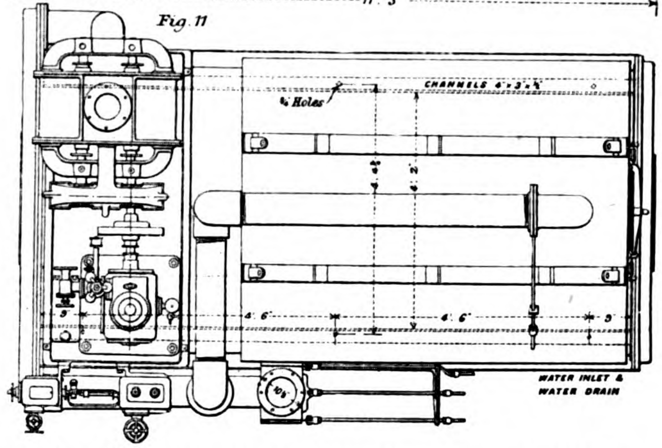
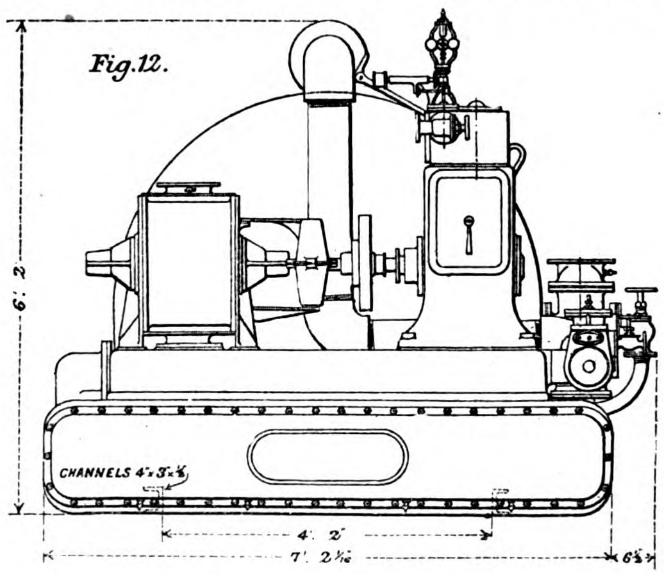


Fig. 11



in the Clayton apparatus. A mast and derrick of Oregon pine, is fitted on each side of the vessel amidships for hoisting hose-coils, etc., on board vessels requiring the services of the boat, the galvanized steel wire falls being led

Fig. 12.



to a steam windlass forward, constructed by Messrs. Fisher & Co., Paisley, and fitted with extended warping ends. Hand steering gear is fitted forward, connected by galvanized wire and chain leads to a quadrant aft, fitted with a gunmetal slipper-block; stand-by gear is also fitted aft. The rails are arranged to be portable where required for fire or disinfecting service, the stanchions being arranged on

Messrs. Forrestt's special principle, to fold down in a fore-and-aft direction. The whole of the deck ironwork, derrick smithwork, etc., is galvanized.

The boilers and propelling machinery, illustrated on Figs. 5 to 9, were constructed and fitted by Messrs. Plenty & Son, Ltd., of Newbury Berks. There are two boilers, of the Yarrow patent water tube type (Figs. 8 and 9), having the shells, side wings, and tubes all of mild steel, and constructed for a working pressure of 130 lb. Each boiler is amply sufficient to supply steam to the main engines at full power, or to the Clayton apparatus and fire-pump, so that the second boiler serves for emergencies. The propelling machinery consists of two sets of compound surface-condensing engines (Figs. 5 to 7), having cylinders 5 in. and 10 in. in diameter, with a 6-in. stroke, feed and bilge pumps being arranged to work from each of the main engines. There is a separate condenser, of circular form, constructed of galvanized steel plate and fitted with S. D. brass tubes. The combined air and circulating pump is separately driven, and a donkey-pump is fitted for feeding the boilers. The bilge duty is performed by the circulating pump on the Clayton apparatus.

One of Messrs. Clayton's "B" type disinfecting and fire-extinguishing machines is fitted on deck amidships, supported by two built-in steel girders fitted under the deck. Machines on this system, as illustrated above (Figs. 10 to 12), have been very largely introduced for fire-extinguishing and disinfecting purposes on board ship and in docks and harbors. The method of operation is as follows: The gas generator is always kept charged with ordinary roll sulphur. As soon as gas is required, the engine, which is coupled direct to a blower, is started, a pint or so of methylated spirit is thrown on the sulphur and ignited, and the charging door of the generator is closed. The blower immediately commences to draw air into the generator through a pipe connecting the return valve (which is operated by the handle H) with the upper part of the hold to be treated, from which the air is thus extracted and brought to the generator (except in the case of cargoes capable of giving off explosive gases, when the air is taken to the generator from the outside atmosphere by a valve operated by the handle K), when the oxygen in the air combines with the burning sulphur, and forms a fire-extinguishing and disinfecting gas. This gas then passes out through a valve, operated by the handle A, along the pipe E, entering the cooler just beneath the engine; it passes through this cooler, in which the temperature is brought down to a normal point, to the blower, and is discharged under pressure through a pipe leading to the hold being treated. The air in the hold is by this means deprived of its oxygen, which is replaced by sulphur dioxide gas. The use of Clayton gas is preferred by many to water or steam for fire-extinguishing on board ship, as it must inevitably reach the seat of the fire, adds nothing to the weight of the vessel, and has no effect on cargoes of food-stuffs or other perishable materials. For purely disinfecting purposes the Clayton gas machines are largely used in ports all over the world. Vermin can be quickly exterminated, and vessels fitted with Clayton apparatus coming from plague-infected ports are granted free pratique, Clayton gas now being recognized as a sure prophylactic measure against the introduction of plague, cholera, etc.

For dealing with open-air fires a fire-pump by Messrs. Merryweather & Sons, Ltd., is fitted forward of the Clayton machine, having a capacity of 4,000 liters per minute, and capable of throwing three powerful jets of water to a distance of 200 ft.

On the trials of the vessel it was proved that she behaved excellently in a seaway. The tests of the Clayton apparatus and fire-pump were satisfactorily carried out and afterwards the vessel was dismantled and shipped to Delagoa bay on board a steamer. The Mozambique government promptly accepted the vessel.

THE ECONOMY AND EFFICIENCY OF THE STEAM TURBINE.

The London *Times* is publishing a series of articles on steam turbines, which contains some very interesting data concerning the showing made by machines of the Parsons horizontal, multiple-expansion, parallel, full annular flow type, that are built in England by C. A. Parsons & Co., Willans & Robinson, and Richardson, Westgarth & Co., in Switzerland by Brown, Boveri & Co., and in the United States by Allis-Chalmers Co., of Milwaukee, Wis.

Turbines of this form of construction, with an aggregate capacity of over 1,000,000 H. P., are now operated in various cities in Europe and the United States for the generation of electric power. Several of the turbines in operation at the plant of the Newcastle Electric Supply Co. are each capable of developing 6,000 H. P. at 1,200 revolutions, under normal conditions, and over 10,000 H. P. on overload. Turbines of similar size and design, put in operation in Switzerland by Messrs. Brown, Boveri & Co., are each designed for a normal output of 12,000 H. P., while similar progress is being made by French and Austrian engineers.

The success of marine turbines for torpedo boat destroyers and high speed passenger vessels has been so widely discussed, both in the technical and popular press, that very little remains to be said at the present time; but the *Times* makes some very significant comparisons showing the results attained with vessels of identical construction except for the type of engines used. The Amethyst and the Topaz, constructed after the same pattern, were selected by the British Admiralty for the purpose of making a series of exhaustive tests, the former being equipped with turbines and the latter with reciprocating engines. The contract speed of the vessels was 21¾ knots and the tests showed that at all speeds above 14½ knots the turbine equipped Amethyst was more economical, namely: 15 per cent at 18 knots, 31 per cent at 20½ knots and 30 per cent at 21 1-10 knots. At full power in each vessel the Amethyst showed 42 per cent more than required by contract on the coal allowed. The Amethyst also reached a speed of 23.5 knots during these tests and the Topaz only 22.1 knots.

More noteworthy results on a larger scale have recently been afforded by the trials of two Cunard liners, the Carmania and the Caronia, each of 30,000 tons displacement and 23,000 I. H. P., the former being fitted out with turbines and the latter with quadruple expansion engines of the latest design. Essential facts concerning the trials of these vessels have been widely published and generally read; but that statement that the Carmania beat the Caronia by about one knot does not give an adequate idea of the relative efficiency and economy of the turbines. It must be remembered that one knot in speed means about 16 per cent more horsepower and that, therefore, the Carmania would appear to be about 16 per cent more economical than her sister vessel driven by the most highly developed type of reciprocating engines; further, that the test of the Carmania was the first trial of turbines on so large a scale, and it may reasonably be expected that improvements in detail will improve upon the noteworthy results obtained. Members of the engineering profession will await with great interest the trials of the two gigantic Cunard turbine vessels of 25-knot speed and 60,000 to 70,000 H. P. now building on the Clyde and the Tyne.

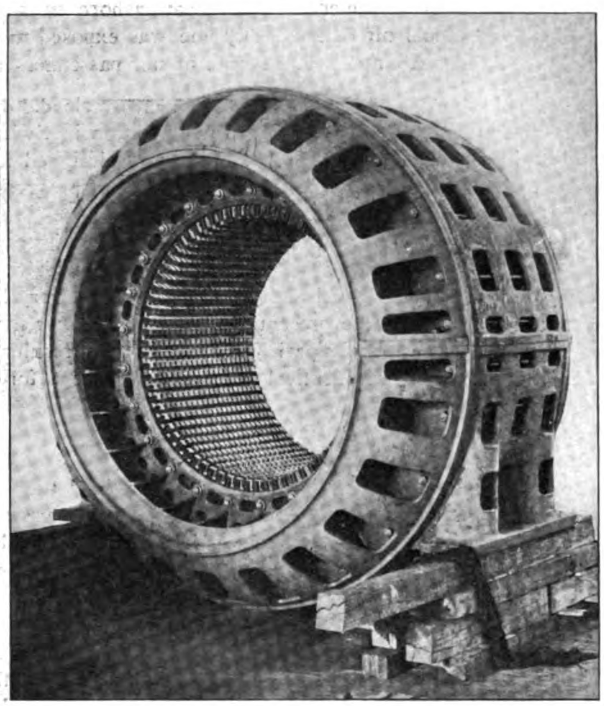
The Nantasket Steamship Co. will issue $100,000 worth of new stock to partly cover the cost of the new steamer building for the company at the yard of the Fore River Ship Building Co., Quincy, Mass.

A LARGE STEAM TURBINE GENERATOR.

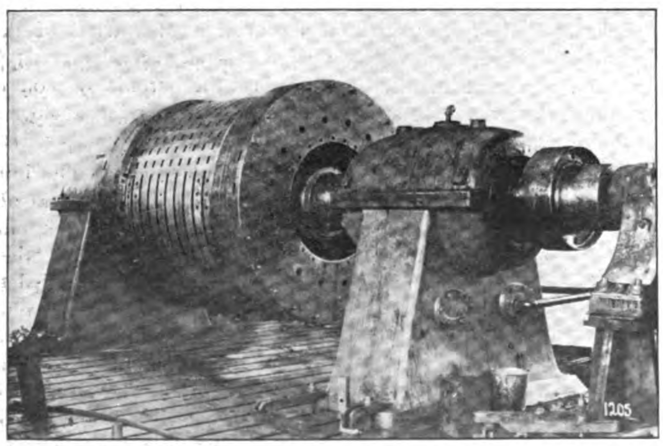
B. A. BEHREND, CHIEF ELECTRICAL ENGINEER, ALLIS-CHALMERS CO., IN *The Electrical Age.*

It is only a short time ago that the installation of a number of 5,000-K. W., three-phase generators in the power houses of the Manhattan and Interborough stations, in the city of New York, attracted considerable attention. A few years ago the capacity of these units was considered very large, and the speed of the Corliss engines operating at 75 revolutions per minute made these generators some of the most gigantic machinery in the world.

Since that time the unwearying efforts of engineers have developed the steam turbine which, in regard to speed, represents a position of greatest antithesis to the reciprocating steam engine. From 75 revolutions per minute with the Corliss engine, we are making the immense stride to 750



revolutions per minute in the steam turbine, increasing the speed tenfold. The diameter of the rotating field of the Manhattan and Interborough generators, turning at 75 revolutions per minute, is 32 ft., whereas the diameter of the rotating field of the steam turbine generators operating at 750 revolu-



tions per minute is only slightly larger than 6 ft. That such difference in operating conditions involves a radical departure from standard engineering practice and leads to machines of altogether different design, may be concluded without much investigation.

A generator of 5,500 K. W., direct connected to a steam turbine, was recently tested at the Bullock Works, at Cincinnati, of the Allis-Chalmers Co. This machine and its performance are interesting on account of numerous novel features as well as on account of the high efficiency, perfect regulation, and low temperature, which have been brought out by tests. Although the normal rated capacity of this generator is 5,500 K. W. at either 6,600 or 11,000 volts, the generator must be capable of standing 6,880 K. W. continuously without rising more than 45 degrees C., and 8,250 K. W. for three hours without rising more than 55 degrees C. On the overload this generator, therefore, will require a prime mover developing 11,500 H. P.

The current developed by this machine has 25 periods, is three-phase, and is generated by a 4-pole magnetic field turning at 750 revolutions per minute. Fig. 2 shows the machine assembled on the test floor; Fig. 1 shows the stationary core or armature; and Fig. 3, the rotating element. Fig. 2 illustrates well the compact design of this machine, due to high speed and the small number of poles; Fig. 1 gives a good view of the thorough lamination and division of the stator core for the purpose of ventilation and cooling; while

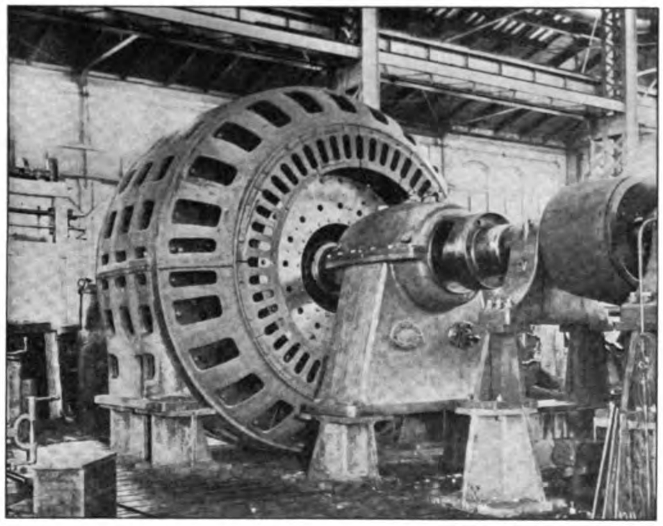


Fig. 3 shows the most interesting part of the machine, namely, the rotating field.

When we stop to consider that the peripheral speed of the surface of this rotating field is almost 15,000 ft. per minute, we realize that we have before us a problem taxing the designing ability of the engineer to the utmost. If we could proceed, either on railroads or on the ocean, at such speeds as this, we should travel from New York to London in approximately 17 hours.

Under such conditions of speed the centrifugal force assumes tremendous magnitude and the careful distribution and calculation of the stresses and strains in the different members of the rotating magnetic field become a matter of the utmost importance and seriousness. The bursting of a mass of steel of 75,000 lb. rotating at the rate of 3 miles per minute, would produce very disastrous effects, and the responsibility of the designer and builder of such machines is, therefore, a very grave matter.

A careful investigation in regard to the stresses and strains produced in rotating discs under the influence of centrifugal force was carried out by the writer several years ago, theoretically as well as experimentally, and it brought forth the interesting result that, in a plain rotating disc, the stresses are a maximum on the inside boundary of the disc and a minimum on the outside boundary. These results, obtained by mathematical analysis, were borne out by experiments on lead discs, the distortion of which was carefully studied by measuring the discs before the speed tests and after, and the

distortion corroborated the correctness of the theoretical conclusions.

Rotating discs, therefore, really do "burst" when they go to pieces, that is, they explode in such a manner that they are rent to pieces by forces which tear the fibre of the material, first on the inside, the rents rapidly being transmitted to the outside. This investigation is of considerable interest with regard to the bursting of emery wheels and grindstones, and it throws much light upon the proper and economical design of wheels of any kind, rotating at high speeds. With the aid of the data obtained through these theoretical and experimental investigations, the foundation of design of the rotating elements of these large machines has become well secured, and the determination of the maximum internal stresses in the nickel steel plates composing the rotating field, illustrated in Fig. 3, can be made with considerable confidence.

The structure of the rotating field consists of ten nickel-steel forgings pressed on a nickel-steel shaft. In order to obtain both high magnetic permeability and good mechanical strength, nickel-steel, containing approximately from 3 to 5 per cent nickel, has been used whose lowest elastic limit is 50,000 lb. per square inch and whose lowest ultimate strength is 80,000 lb. per square inch. The highest stress existing in any one part of the rotating element does not exceed 15,000 lb. per square inch. At normal speed, therefore, the lowest safety factor is almost 5½, showing that these rotating fields might be run at twice their normal speed without flying asunder.

A problem of extreme difficulty confronts the designer in placing and securely fastening the field windings to these large steel blocks in such a manner that neither the copper conductors nor the insulation between them and the magnetic field can be injured by the centrifugal force to which they are exposed. To this end flat copper strips have been wound on special designed formers, which are made in such a manner as to give an ever-increasing opening to each sucessive turn, and they are lodged in radical slots, milled into the nickel-steel discs, and held in place by retaining wedges made from Parsons manganese bronze. The construction is so solid that it might well be said that a cannon could not be made stronger and more reliable. The end connections of the field coils rest against nickel-steel end rings, which also are shown in Fig. 3.

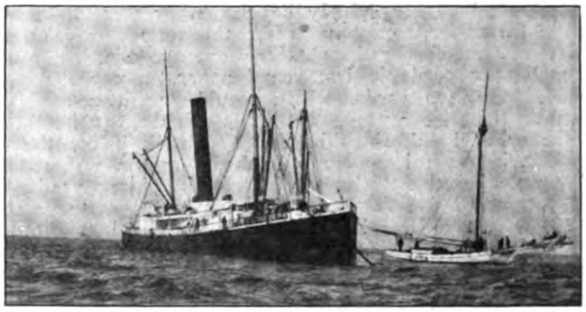
Owing to the rotation of the revolving field, air is blown through the ventilating segments of the stator, cooling the core as well as the coils. The efficiency of this ventilation is well demonstrated by the fact that, though operating at a core loss of 47 per cent above the normal, the temperature rise of the core, after continuous operation, did not exceed 22½ degrees C., and this result was obtained with comparative little noise and power. The satisfactory ventilation of the field coils has also been demonstrated.

The electrical efficiency of this generator, as actually obtained from tests, is 94.4 per cent at ¼ load; 97 per cent at ½ load; 97.9 per cent at ¾ load; 98.3 per cent at full load; 98.5 per cent at 1¼ load, and 98.6 per cent at 1½ load. The regulation of the generator at full load at 100 per cent power factor is 7½ per cent, and yet the generator has enough margin to give its full rated output on any power factor, however low.

Another question of great importance in the design and operation of the high-speed revolving-field generators is created by the tendency towards vibration which, in improperly designed machines, may become a source of very serious difficulty. The heavy mass of the rotor, put on a shaft, corresponds exactly to the mathematical combination of a mass and a spring attached thereto, which is the simplest form of a vibratory system. Such a system, by alternately yielding up and storing energy, is capable of vibrating violently under certain conditions favorable to the existence of such vibrations, and it becomes a problem of paramount importance to determine the natural period of vibration of the rotating element of a generator operating at such high speeds as the large machine here described. By carefully studying this problem and choosing such dimensions for the shaft of the machine as will correspond to the natural vibration of the rotating element, as much different as possible from the period of vibration produced by unbalancing at the normal rotative speed, it is possible to obtain safe and steady operation without fear of vibration. To steer clear among the many reefs that beset the course of the engineer in the creating of large apparatus designed upon lines heretofor unknown is a problem all the more interesting because of its difficulty.

STRANDING OF THE CHEROKEE.

The Clyde Line steamer Cherokee ran ashore in a fog on Brigantine shoal off Atlantic City and was exposed to the full force of the Atlantic. The rescue of her passengers and



STEAMER CHEROKEE STRANDED.

crew is one of the most daring and most brilliant acts in the annals of the sea. Thousands of dollars were later subscribed by the rescued and given to the rescuers. The cargo was thrown overboard in the hope that the vessel thus lightered would rise but so far she has not done so.

NEW STEAMER FOR THE ST. LAWRENCE.

The Richelieu & Ontario Navigation Co., Montreal, has let contract for a twin-screw passenger steamer for the St. Lawrence River Rapids Line. The new steamer will be 240 ft. over all, 41 ft. beam at main deck, 43 ft. beam over wales and 6 ft. draught. She will have ninety-four staterooms, four parlors and two bath rooms. Her speed will be 18 miles an hour. The promenade deck will have forward a large observation space for passengers. Next after this will be a cabin for sheltering passengers in stormy weather. The space after this cabin to the stern of the boat will be devoted almost entirely to stateroom accommodations for passengers, with merely a small cabin at the after end of this deck just forward of a small open passenger space at the extreme stern. The hurricane deck will be left entirely open, that is, with no obstructions whatever except for a small cabin with staterooms and will be used as an observation room for passengers when running the rapids. The hurricane deck will be extended to the stern of the boat and will be covered with a light awning roof. The pilot house and texas will be on this deck, the pilot house being sufficiently raised for handling the boat with passengers in front of the pilot house. The steamer is expected to go into service during the coming season. She will be built by the Canadian Ship Building Co., Toronto. The company is now making arrangements for a full-sized canal passenger and freight steamer for the Hamilton-Montreal Line and also for a steamer for the Montreal-Quebec route to run opposite of the steamer Montreal, which is one of the finest passenger boats in Canada.

The Cruiser.

BY COM'DR. WILLIAM HOVGAARD, ROYAL DANISH NAVY, MEMBER.*

The following discussion may be considered a continuation of my paper on "The Sea-going Battleship," which I had the honor to read before this society last year: Since then the great naval battle by Tsushima has taken place, and although the details of this battle are imperfectly known, several valuable facts stand out clearly. Perhaps the most important experience is that long-range fighting is possible to an extent not anticipated before the war, a direct consequence of which is an enhanced value of heavy guns as compared with guns of semi-heavy or medium calibers. This corroborates the opinion expressed in last year's paper, that the caliber of secondary guns should be chosen as near to that of the heavy guns as due regard to its characteristic feature will permit. Guns of 9.2 in. or 10-in. caliber were then recommended, but it seems likely that the war experience will tend to hasten the development in this direction.

Another consequence of long-range fighting is, that the assumed average fighting distance, on which armor protection should be based, may be chosen greater than before, and that consequently armor thicknesses may on the whole be somewhat reduced. The average fighting range, assumed 3,500 yards in last years' paper, may probably be increased to 4,500 yards, which would permit a reduction in armor thickness on the battleship of about 1 in. K. C. On the other hand, ships have been struck below the armor belt in several instances, and the armor weight saved by reducing the thickness should therefore partly be used to extend the depth of side armor below the water-line. The inner lateral coal bunker bulkhead might also with advantage be strengthened as protection against torpedo explosions.

On the whole the war experiences, as far as known, have borne out the conclusions arrived at in last year's paper. The overwhelming importance of guns compared with torpedoes as armament for large ships has been proved; the value of a complete system of armor protection, of rational and efficient watertight subdivision and of great initial stiffness have all been emphasized. [The Osljabja is reported to have capsized after having received the second shot wound in the water-line.] The opinion that large size is necessary for a sea-going battleship has been confirmed.

In passing from the sea-going battleship to the cruiser, the general principles explained and stated in last year's paper will apply with but few modifications to the cruiser. As an introduction, some of those principles shall here be stated, and, where needed, their applicability to cruisers shall be discussed.

1. The design should in every respect be based on probable average conditions.

2. The large ship may, due to greater load-carrying capacity, be made superior to the smaller in speed, gunpower, and protection; but moreover, it is inherently superior in point of nautical qualities, water-tight subdivision, economy of propulsion, and in the relation of sea speed to trial speed. These qualities are not subject to addition, and cannot, therefore, be compensated for by a greater number of units.

3. The armor protection should be "corresponding" to the armament, i. e., it should be such as will enable the cruiser to keep up a long continued fight with an equally powerfully armed antagonist under average conditions of fighting.

This principle has in many cases not been followed in cruisers, and will probably be objected to by many; it is believed, however, that the arguments put forward in last year's paper in the paragraph "Relation between Armament and Armor" will be found to apply to cruisers as well as to battleships, and in fact to all ships which carry artillery as the principal weapon.

Also the distribution of armor should in all classes of cruisers be in accordance with the principles stated for the battleship:—

4. The armor protection should be proportional to the relative importance of the part to be protected.

5. The protection of the ship should take precedence over that of the guns.

In designing the location and extension of armor, we have even in the smallest cruisers to meet conditions analogous to those in the battleship. The assumed average conditions may indeed be different in degree, but not in kind, and the parts to be protected are arranged in essentially the same way in the two classes of ship. We must, therefore, arrive at a system of armor distribution in the cruisers practically identical with that in the battleship.

The question of deck armor versus side armor is treated in the appendix. This treatment is an extension of that found in last year's paper and contains a more complete solution of the problem. It is found that, as far as armor-piercing is concerned, deck armor and side armor stand about even in battleships, i. e., a given weight of armor may as well be applied to the side as to the deck, while in cruisers deck armor is somewhat more favorably situated. But in all classes of ships, side armor is more effective in keeping shell explosions and shrapnel out of the ships, and it protects not only the vitals but also the buoyancy and stability. Hence we conclude, as for the battleships, that:—

6. The armor weight should be chiefly applied to the sides, and no more weight should be given to the armor deck than necessary to its functions as a splinter deck.

The great divergency which we find in the design of cruisers is largely due to disagreement on the principles of protection. While these principles, as stated above, are now fairly followed in all recent large cruisers, this is far from being the case in cruisers of the smaller types.

It is argued by many that small, fast cruisers are not real fighting ships, and that they need not, therefore, be given a complete system of protection; that their best protection lies in a powerful battery by which they are able to deal a crushing blow to an adversary before he has had time to reply effectively (Elswick cruisers). On basis of these arguments the so-called "protected" cruiser type, with only deck armor and a relatively heavy battery, has been retained for smaller ships, with few and quite recent exceptions. The water line and the upper works have received no protection, and guns even of large caliber (up to 10 inches) have been given only a light shield or no protection at all.

The insufficiency of this system was evident in the Variag at Chemulpo, where the sides were pierced in a number of places, and the ship took a heavy list. No shields were fitted to the guns, the screws of which were repeatedly swept away by shell fire; the complete absence of gun-protection is said to have acted extremely demoralizing on the men.

If a ship with numerous poorly protected guns and no water-line protection falls in with a vessel of similar design, it will depend on skill or on mere chance, which of the two adversaries is first destroyed, since an effective shot at the beginning of the fight is likely to determine the issue.

Such a design is, therefore, not based on average circumstances, but on superior skill or on mere luck. How mistaken we may be, one way or the other, as to the qualities of the personnel will be admitted, and the designer should, therefore, always consider these qualities as well as the chances of war to be even.

Cruisers of the fast, small type will not, in the performance of their principal duties, need guns of large caliber, since the only enemies which they ought to fight are all lightly protected or unprotected, but they do need some protection in order to fight such enemies, namely, that "corresponding" to the guns. If the system of protection is to be complete, this claim will of course put an early limit to the caliber.

As to number of guns it is better to have a smaller number of properly protected guns than a large number of unprotected guns.

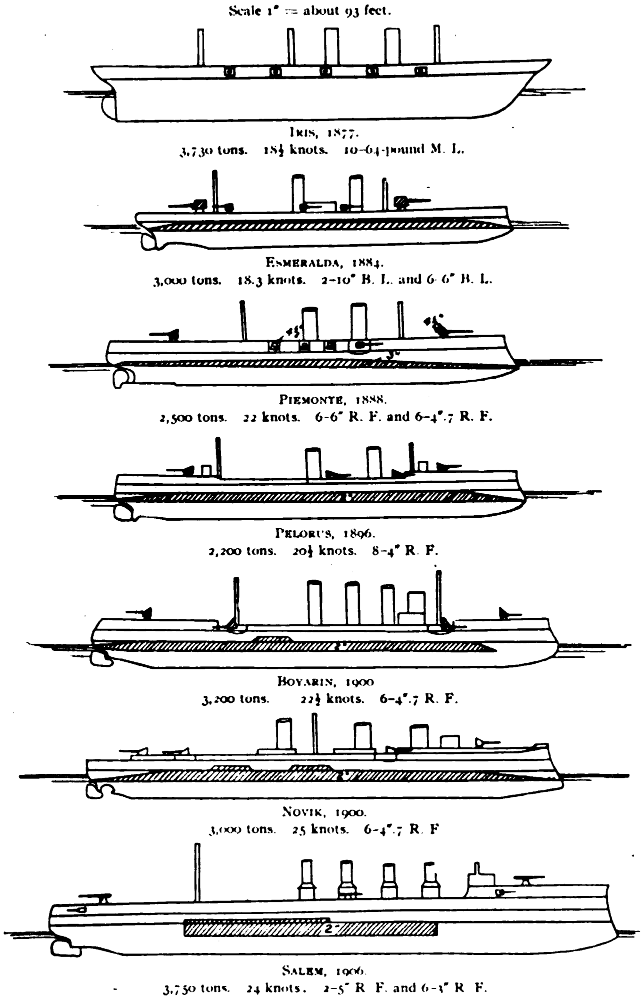
The closed turret installation seems here, as in the large ships, to be the best, in view of the innumerable fragments from high explosive shell, against which shields are only an imperfect protection. In the Russo-Japanese war the men behind gun shields were often badly wounded in their feet from such fragments. Shields should, therefore, only be used for the lightest guns, and the question of mounting 4-in., and even 3-in., guns in turrets on board small ships should be seriously considered.

*Paper read before the Society of Naval Architects and Marine Engineers, New York, Nov. 16, 1905. For discussion of the Society upon the paper see MARINE REVIEW Nov. 23.

The system of water-tight subdivision recommended for the battleships can only be partly carried out in cruisers; the relatively smaller beam, and in most types also the smaller displacement, imposes limitations, but the same general plan should be followed. Center-line bulkheads should be avoided in cruisers still more than in battleships on account of the smaller metacentric height, and should be fitted only where necessary between engine rooms. Doors in the principal transverse bulkheads should be avoided.

Before entering upon a discussion of the type and design of cruisers, which will be most suitable to existing conditions, a brief historical review shall first be given, with a view of studying the relation between the development and the causes which have produced and governed it. Thereafter these causes, as they exist now, and especially the present requirements of the service shall be analyzed, and we shall thus obtain what is believed to be the best possible guide for future development.

SCOUTING CRUISERS.
Scale 1" = about 93 feet.



HISTORICAL REVIEW.

With few exceptions the development of the modern cruiser was, up till recent years, almost entirely governed by that of the English and French navies. The underlying policy has, in these two countries, generally been clearly defined or readily distinguishable, and the history of the cruiser, as far as a study of causes and effects is concerned, is therefore well represented by that of English and French cruisers, while reference to other navies need only be made in a few cases.

The original conception of a cruiser dates back to the days of sailing frigates, light, fast vessels built for scouting, for attack on or protection of commerce, and for detached service.

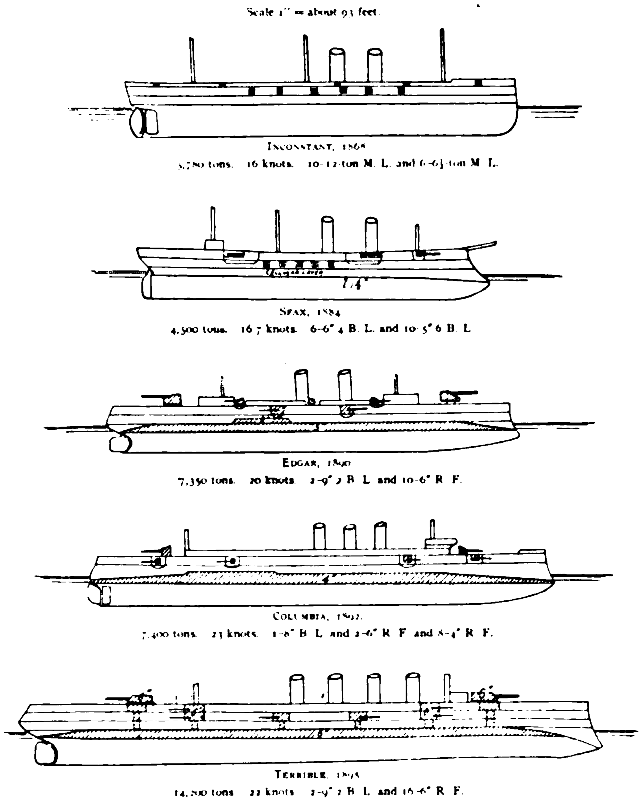
After the introduction of steam, the importance of this type seems to have been lost sight of to some extent, until the success as a commerce destroyer of the steam propelled cruiser Alabama (1862) drew the attention of the world to this class of vessel. The immediate result was the creation of larger and more powerful types for the protection of commerce (Wampanoag, Inconstant, 1868). The armament of these ships was comparatively heavy, but they were entirely unprotected.

The differentiation in size which here originated has, broadly speaking, been maintained ever since, but near 1890 a further subdivision of the larger type took place, as explained hereafter. The smaller class was generally destined for commerce destroying, while some were built more especially for scouting and despatch service (Iris, 1878). The larger type was intended chiefly for protection of commerce and also generally for service on distant stations; on account of the growing claim to protection it showed a tendency to increase in size. Already, at the end of the seventies, the "protected" cruiser was inaugurated by the Comus class (1878). The protected cruiser was characterized by having an armor deck and by the total absence of side armor, the buoyancy and stability being chiefly protected by a cellular subdivision in the region of the water-line and by a belt of coal. In order to gain weight for the protective deck, the armament, and at first also the speed, was somewhat reduced, but by improvements in machinery, by the abandonment of sail-power and by a lighter hull construction, the speed was soon raised even to the level of earlier despatch vessels. In the Elswick cruisers also a heavy armament was carried (Esmeralda. two 10 in. B. L., and six 6 inch B. L. 1884), but this was not done without sacrifice in seaworthiness (low freeboard) and in coal capacity.

From this period dates the idea of using cruisers against or as a substitute for ironclads, advocated in England by Lord Armstrong, in France by Admiral Aube. At that time many armorclads presented weak points in their unprotected ends (Admiral class) or in their large unprotected superstructures (French ships), and this new idea, therefore, gained considerable influence and even caused a temporary pause to be made in armorclad construction in most navies. In a few years, however, rapid firers, high explosive shell and the introduction of powerful secondary batteries in armorclads put an end to this notion, as far as protected cruisers were concerned.

The proper duties of protected cruisers were more clearly realized, and with the introduction of rapid firers smaller calibers of guns were used in the vessels (Piemonte, six 6 in. R. F. and six 4 in., seven R. F., 1888).

LARGER UNPROTECTED AND PROTECTED CRUISERS.
Scale 1" = about 93 feet.



The larger class of cruisers was generally protected on same principle as the smaller (Mersey, Sfax, Chicago, all from the middle of the eighties), but the progress in ordnance made it increasingly desirable to give a better protection to the water line. Hence a still larger type,

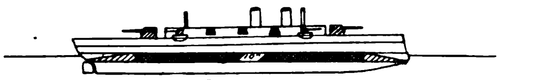
the so-called "armored" cruisers, was gradually developed, characterized by the combination of deck armor with a more or less extended side protection.

The early armored cruisers were nothing but reduced copies of the battleships; the Vauban (1882) resembled the Admiral Duperee, the Orlando (1886) resembled the Admiral class. This seemed, indeed, perfectly logical, but in this way these cruisers came to share the defect of the armorclads of that time, a too great concentration of armor. The attempts made with armored cruisers had up till the end of the eighties been sporadic and not all of them successful, but from about 1890, after the construction of the French cruiser Dupuy-de-Lome, dates the permanent introduction of the armored cruiser. In order to understand this step in the development and the subsequent rapid growth of the large cruiser, we must consider the peculiar and in some respects unique position of the two leading countries.

France considered herself at that time as the possible

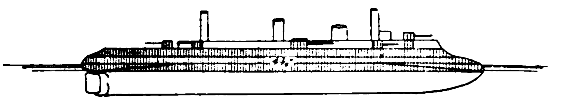
ARMORED CRUISERS.

Scale 1" = about 93 feet



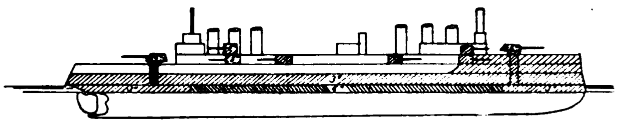
ORLANDO, 1886

5,600 tons. 18 knots. 2-9".2 B. L. and 10-6" B. L.



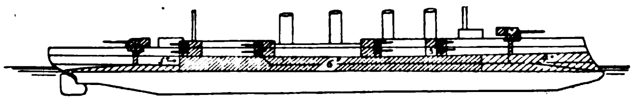
DUPUY-DE-LÔME, 1890.

6,500 tons. 20 knots. 2-7".6 R. F and 6-6".4 R. F.



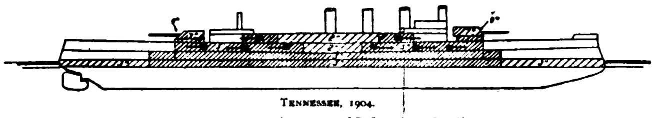
JEANNE D'ARC, 1899.

11,300 tons. 22 knots. 2-7".6 R. F. and 14-5".5 R. F.



DRAKE, 1901.

14,100 tons. 24 knots. 2-9".2 B. L. and 16-6" R. F.



TENNESSEE, 1904.

14,500 tons. 22 knots. 4-10" B. L. and 16-6" R. F.

enemy of England and as her rival on the sea. The history of former wars where French cruisers inflicted so much damage to British shipping, had not been forgotten in France. Now more than ever before was the sea-borne trade the vulnerable point of England, for on it depended the economic life and even the food supply of the country. France also felt it increasingly difficult to compete with England in the building of large armorclads, and it was, therefore, natural that a policy of ship building based on commerce destroying should find favor in France.

A number of small, very fast, protected cruisers, and a few larger vessels of same type had already been built or were under construction, with the main object of eventually preying upon British commerce in distant seas (Tage, 7,600 tons, 1886; Cecille, 5,900 tons, 1888).

It was, however, soon realized by the French, that these large vessels, with their extensive unprotected sides, were too vulnerable in view of the widespread and violent effect of rapid firers and high explosive shell. Experiments on the effect of high explosive shell with La Belliqueuse fully confirmed this opinion, and showed the necessity of giving a much more extensive armor protection to the sides than had been given in the early armored cruisers. On the other hand the thickness of armor would only need to be moderate (4 in.).

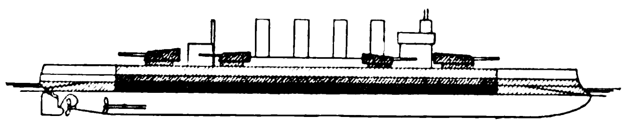
These considerations led to the construction of Dupuy-de-Lome (6,500 tons, 1890), which besides an armor deck, had the sides completely covered by armor up to the upper deck, and which was moreover a fast and well-gunned ship (heavy guns 7 in. 6).

During the nineties France built several cruisers of the Dupuy-de-Lome type. The extension of armor was somewhat reduced, and since at the same time the armor of the battleships was extended more and more up the side, we find that at the end of the decade the distribution of armor on the French cruiser was essentially the same as that on the French battleship. Also the guns were similarly disposed and protected in the two classes. At the same time, however, also large protected cruisers were constructed in France, such as the commerce destroyer Guischen (8,000 tons, 1897).

The Dupuy-de-Lome found many admirers; not only did it seem well adapted to commerce-destroying in distant seas, but it also caused a revival of the idea of substituting cruisers for battleship. Admiral Fournier advocated for this purpose an enlarged Dupuy-de-Lome, and at the end of the decade a great step in size was taken by the construction of the first-class cruiser Jeanne d'Arc (11,300 tons, 1899). This ship was well suited to meet the large protected cruisers built by England in this period, but it was in spite of its great size entirely unfit for fighting

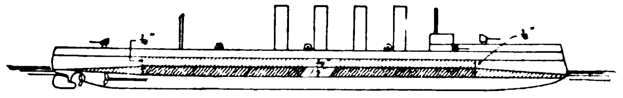
DIAGRAMMATIC SKETCHES OF PROPOSED CRUISER TYPES.

Scale 1" = about 93 feet.



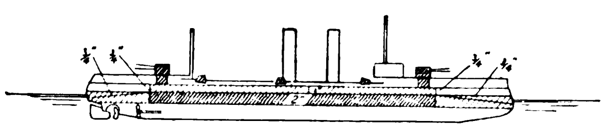
BATTLESHIP-CRUISER.

Displacement: about 20,000 tons. Speed: 21 knots. Armament and Protection (same as in battleships, armament here assumed: 4-12" and 8-10" guns).



SCOUT.

Displacement: about 5,000 tons. Speed: 25 knots. Armament: 10-4".



CRUISER FOR SAFETY SERVICE, ETC.

Displacement: about 3,000 tons. Speed: 20 knots. Armament: 4-5" and 6-3".

battleships, for which purpose both its armament and protection were insufficient.

England, on the other hand, in view of the strong development of the cruiser in France and elsewhere, realized the necessity of making special efforts for the protection of her commerce. To every type of cruiser built in other countries, and especially in France and Russia, England replied with the construction of another type, which was thought more powerful. Thus the Dupuy-de-Lome was followed in England by the Blake and Blenheim (9,000 tons, 1890-'91) and the Edgar class (7,350 tons, 1890), all of the protected type. Thus arose the subdivision of the large cruiser class referred to above, and henceforth we have at least three classes, first, second, and third, of which again the first and second are divided into protected and armored cruisers.

The English persisted through the nineties in the construction of cruisers of the protected type. In all classes size was increased in order to gain endurance, seaworthiness and speed without reduction in military power, and a fleet of nearly 80 protected cruisers, largely of intermediate sizes, was constructed in this decade, ranging in displacement from 2,000 to 14,000 tons. The largest type was the Terrible (14,200 tons, 1895), built as a reply to the Russian armored cruisers Rurik and Rossia.

The idea was to use large cruisers for protection of commerce by patroling the open ocean, second-class cruisers should be used for patroling and eventually for convoying merchant ships in home waters, and the third class should be used chiefly as lookout ships. For the further protection of commerce, old armorclads of reduced fighting value were to be used as convoys for merchant vessels in the east; they were, therefore, classed as arm-

ored "cruisers," but this term must here be considered a misnomer, since they had nothing in common with cruisers, except that they were used for what was usually considered cruiser service. Many of the English cruisers carried 9.2 in. guns, and were in this respect more powerful than the French, but on the other hand, their unprotected sides made them entirely unfit for standing modern shell fire. Bearing in mind the standpoint of ordnance at the end of the decade, it is probably not too much to say, that the protected cruiser had, by the year 1900, become an obsolete type. Even the largest of this class of vessel was exposed to destruction by the guns of medium caliber with which both cruisers and battleships were provided.

About that time the English finally abandoned the protected type of cruiser for all larger sizes, and adopted an armored cruiser type, which in arrangement of guns and armor was very similar to the English battleship. Both hull and gun bases received a better protection than in the protected cruiser. With characteristic energy England has in the few years since that time more than regained the lost ground by constructing a fleet of nearly forty powerful armored cruisers, ranging in displacement from 10,000 to 15,000 tons. In the same period France has built a number of large cruisers of improved Jeanne d'Arc type. In both countries the development of the armored cruiser, since 1900, has been characterized by a rapid increase in gun caliber, and by the distribution of guns and armor on a plan closely resembling that of the battleships in the respective countries.

The armament is sufficiently powerful to inflict serious damage to battleships outside their heavy armor, and the protection is sufficient against guns of medium caliber, but for fighting heavy armor and heavy guns these ships are too weak. The speed has been kept some 20-25 per cent higher than that of the battleships.

In the United States the development in this period has taken the same course. The Charleston class (9,700 tons, 1903) is, for its size, weakly protected and gunned (6 in.), and does not indeed differ much from the protected cruiser, with which it is actually ranked; the Pennsylvania (13,680 tons, 1903) class is in both respects better provided, but the armored area is restricted and the caliber of the heavy guns (18 in.) is small for a ship of so great displacement. The Tennessee class (14,500 tons, 1904) marks a great improvement, carrying heavy armor-piercing guns (10 in.) and having a rational system of protection. The approach to the battleship type, as regards arrangement of armor and guns, has here, as in the English and French cruisers, been completed, the difference between large cruisers and battleships being now in all navies only one of degree.

The fighting capacity of the armored cruiser has reached a point which renders its participation in future fleet actions almost a certainty. We have already seen armored cruisers so used with great success at Tsushima, where some of them even went in line with the battleships. This contingency cannot fail to produce a further increase in military strength of these vessels, and has probably already contributed to the marked advance in this respect which has recently taken place. Since the year 1900 the construction of intermediate sizes of cruisers (second class), such as were built so profusely and in such great variety in the nineties, has almost ceased in the leading navies. It remains to describe the development of the third-class cruiser, and to show how the modern "scout" type evolved.

Small fast cruisers, of displacements between 2,000 and 4,000 tons and of increasing speed, continued to be built during the nineties as before that time (Cincinnati, 19 knots, 1892; Galilee and Pelorus, 20-21 knots, 1896; Bojarin, 22½ knots, 1900). The ships of this period carry a relatively heavy armament and protection; the high speed having been attained by cutting down weight of hull and machinery (boilers). The speed is, however, inferior to that of many large cruisers (Drake and County classes, 23 knots), especially in a seaway, although very useful can, therefore, not be entrusted with scouting at great distances from a base. Thus arose the claim for a still faster type, the ocean scout, inaugurated by the Novik (3,000 tons, 25 knots, 1900). The high speed reached in that ship was obtained by an exceedingly light hull construction and low freeboard, by small machinery weight (Thornycroft boilers) and small coal supply, while the battery was rather heavy (six 4.7-inch guns). In later types weight has been saved by reducing the gun power, as in the Pathfinder class (3,000 tons, ten 3-inch guns, 25 knots), and the Salem class (4,000 tons, two 5-inch and six 3-inch guns, 24 knots). The former type has very low freeboard and small coal supply, the latter has high freeboard and larger coal supply; the somewhat lower trial speed in the Salem class will probably be more than offset by its better sea-going qualities and relatively higher sea-speed, but compared with recent armored cruisers, the speed of the Salem class is still too low. Only by a further increase in displacement does it seem possible to obtain a type which combines sufficient speed with great endurance and seaworthiness. Side armor is here used for the first time in third-class cruisers, but only as a belt of very limited extension.

SYNOPSIS OF HISTORICAL REVIEW.

Summing up the various causes which have been operative in the development, we find first a natural tendency to growth in size in accordance with the principle stated at the beginning of this paper; and secondly, a development due to general technical progress. Both of these causes are still active and may be expected to produce in future the same tendency to increase in size and progress in quality that has characterized the past. The controlling factor in the determination of types and also largely in the development within each type has, however, been the requirements of the service, but the teachings of history are here, on account of the peculiar strategical and economical condition of the leading countries, not of general application, and conclusions can, therefore, only be drawn with great discrimination.

As evident from the brief historical review, the importance of the purely military duties incumbent on cruisers, has in England and France been overshadowed by the attention which has been given to protection of and attack on merchant vessels. Chiefly on basis of this service, types have been determined, and the example of the leading navies has generally been followed by other navies, in many cases rather indiscriminately.

Expediency and opportunism have also played a great part in the development, such as must indeed always be the case. Thus there has always been a tendency to meet each new class of vessel, created by a rival navy, with another still more powerful. This tendency has, for instance, been very marked in the English navy.

GENERAL REMARKS ON CHOICE OF TYPES.

Since on the whole the tactical and strategical duties, on which ultimately the issue of campaigns depends, have received but secondary attention in the past by the determination of cruiser types, we cannot expect that the existing types should be the best for such service. Even granting that they are necessary for countries for whom war on commerce, whether offensive or defensive, is an all-important consideration, it seems improbable that they should be the best general types even for such countries. For other countries, such as for instance the United States for whom war on commerce is unimportant, it is likely that types, chosen directly or indirectly on basis of such warfare, will be more or less unsuitable. We cannot, therefore, in this matter safely go by precedent, but must study the question of types on independent grounds, by first considering all the duties which cruisers will have to perform, and by assigning to each kind of duty its proper weight, according to the needs of the country.

Since control of the sea must always be the ultimate object of naval warfare, and since this can only be attained by defeating or effectively blockading the enemy's main force, the consideration of the purely military duties should in all navies take precedence over those relating to commerce protection and destroying, etc. On this principle the types should be chosen, and we shall, therefore, in the following commence the discussion with a study of types suitable for the former service, and thereafter examine whether and to what extent it will be necessary to create special types for the performance of the latter service.

In land warfare small bodies of cavalry may one day act as independent patrols or scouts, and the next day they may form an integral part of a regiment, but in naval warfare no such integration of the units can be effected; no number of small cruisers can, by acting together, become the equivalent of a large cruiser. Each type has its limitations in use, and the more so, the smaller it is; once we have created a type, we have to accept its shortcomings.

Large ships are on the other hand better adapted for performing the duties of somewhat smaller ships than conversely. Hence we are led to prefer a larger type to

the intermediate types, which, although suitable for some particular service, are unsuitable for other and as we shall see, more important service, which they may be called upon to perform.

Since, however, small ships cannot be dispensed with for service where small dimensions and great number are primary requirements, we arrive at two main groups of cruisers, large and small. Within these groups, the number of types should be the smallest possible, consistent with the requirements of the service, and ships of intermediate sizes should only be constructed when absolutely necessary.

The conception of a cruiser is inseparably connected with the idea of speed—speed as a prominent quality is common to all sizes and types of cruisers.

If, therefore, we shall define the duties of this class of vessels, we must examine what service does in particular require high speed for its perfomance, i. e., speaking generally, a speed higher than that of the battleships.

A. Cruisers for Tactical and Strategical Service.

For the sake of clearness large and small cruisers shall be discussed separately.

1. LARGE CRUISERS.

The service for which large cruisers are required may be defined as follows:

A. RAPID CONCENTRATIONS DURING FLEET ACTION.

For the performance of these tactical duties it must be of the greatest value to the commander of a fleet to possess ships endowed with higher speed than the main body of battleships. The importance of the element of speed in fleet action was shown in the use which Admiral Togo made of his armored cruisers in the battle of Tsushima. In order however, to derive full benefit of such faster ships, they should be gunned and protected so as to meet the battleships on even terms, i. e., they must themselves be battleships.

B. SUPPORT AND ASSISTANCE OF SMALLER CRUISERS.

By scouting, safety service, and blockade of military ports smaller cruisers are detached to advanced positions, and will here need support and assistance of more powerful ships, behind which they may seek shelter, if needed, and which will generally assist them by taking an active part in their service. Such supporting ships will need high speed in order to avoid being cut off by the enemy's battleships. High speed will also enable them eventually to chase the enemy's cruisers, and will be generally useful in the service here described. The fighting power should not be less than that of armored cruisers.

C. RECONNAISSANCE IN FORCE.

When a battle is imminent it is often of the greatest importance to ascertain the strength and position of the enemy (Rosjestvensky and Togo). This information cannot always be obtained without breaking through a screen of light and possibly armored cruisers, and such reconnaissance requires for its performance ships of high speed and great fighting power.

D. INDEPENDENT EXPOSITIONS.

Frequently it is required, on short notice, to send ships out to distant stations, as in case of military demonstrations or operations of smaller magnitude. Often considerable fighting power is required in order to meet all possible contingencies. Also high speed and great endurance are here needed.

CHOICE OF TYPE.

Comparing the relative importance of the duties assigned to large cruisers, it will probably be admitted that the tactical duties in fleet actions must be ranked above duties pertaining to reconnoitering, not to speak of the incidental service which, in time of peace and war, may be entrusted to cruisers. A great naval power must, therefore, first of all, possess cruisers that are perfectly suited to the former service, and it has already been stated that such vessels should simply be fast battleships. A reduction in gun caliber and in protection, as found in the ordinary armored cruiser, would make the type essentially inferior to the battleship. A reduction in number of heavy guns, retaining the caliber the same as in the battleship (Vittorio Emmanuele), seems irrational, since the saving in weight hereby attained will only be small, if the protection is not to be sacrificed also.

But if armament and protection is to be exactly the same as in the battleship, and if in addition the speed is to be higher, it is clear that, other things equal, the displacement must be greater. Thus we arrive at a new type, an enlarged and fast battleship, which in the following shall be referred to as the battleship-cruiser. The battleship-cruiser will, compared with the armored cruiser of to-day, possess all the advantages inherent in the larger ship, as stated above, and it will possess the fighting capacity of a battleship. The sea speed, if not the trial speed, may probably, without undue increase in displacement, be made as great as that of the armored cruiser, taking sea speed to mean the highest speed sustained for a considerable time under average conditions of wind and sea.

If a fleet of battleships is accompanied by a squadron of battleship-cruisers, the element of high speed seems to be sufficiently provided for, and it will be unnecessary to give the ordinary battleship more than what may at any period be considered a moderate speed (at present about 18 knots). Thus the displacement of ordinary battleships and their cost may be kept within reasonable limits. The other duties assigned to large cruisers under (b), (c), and (d) would not necessarily demand for their performance ships of so great power as the battleship-cruiser, the ordinary armored cruiser would be sufficient; but, as mentioned above, such vessels will unavoidably be forced also to take part in fleet actions, and for this service they are too weakly gunned and protected. It may be argued that the Japanese armored cruisers did excellent service in the battle of Tsushima, but this battle cannot be considered a reliable test of the type, because the better gun practice of the Japanese outweighed even great differences in material. The first-class armored cruiser, as it is to-day, although a vast improvement on what is was only a few years ago, is still only partly suited for the duties which it may be called upon to perform, and cannot, therefore, be considered a fully satisfactory type. On the other hand the battleship-cruiser is not only the best cruiser type in fleet action, but is also eminently adapted for all other duties incumbent on large cruisers. If used as support for an advanced line of smaller cruisers, it is able to hold its position longer than the ordinary armored cruiser, and is better able to stay the advance of hostile cruisers. A reconnaissance, involving a violent penetration through the outer lines of the enemy, can be performed with greater impunity by this type. Finally the battleship-cruiser can, more safely than any other type, be entrusted with independent expeditions to distant stations, as indeed with any detached service.

The only serious objecion to this new type appears to be its great cost, and the consequent small number of units that can be built for a given expenditure, but consideration will show that for the most important of the military duties stated above, it is concentration of power, and not a great number of units that is wanted. Hence, it is concluded, that at least for all strictly military service the armored cruiser should be abandoned, and a new, more powerful type, the battleship-cruiser, put in its stead.

GENERAL FEATURES OF THE BATTLESHIP-CRUISER.

The general features of this type can only be determined relative to the type of battleship as it exists at any given time. It may be derived from the battleship as a somewhat finer vessel with a greater ratio length to beam, and with a power sufficient to drive it at some 15 to 20 per cent higher speed, but with same battery, same thickness, and distribution of armor. What this battery should be and how the armor should be distributed has already been discussed in last year's paper. In the accompanying diagram the armament is supposed to be 4.12 in. and 8.10 in. guns. If we assume the ordinary battleship to be of some 17,000 to 18,000 tons displacement and 18 knots speed, the speed of the battleship-cruiser should be about 21 knots, which would probably require a displacement of about 20,000 tons, other things equal. An increase in speed could of course be obtained by higher forcing of machinery or by reduction in hull weight, but this does not seem justifiable in the battleship-cruiser any more than in the battleship.

An increase in speed attained by improvements in machinery (turbines, liquid fuel, etc.), would benefit both types alike, and would, therefore, not affect the position of the battleship-cruiser relative to the ordinary battleship.

2. SMALL CRUISER.

The service for which small cruisers are required may be defined as follows:

a. Reconnoitering or scouting, whereby vessels are sent out in direction of the enemy until contact with him

is gained. Once contact is obtained, it is generally required to be kept, and the scouts should endeavor to approach the main fleet of the enemy so as to discover its position and ascertain its strength. Fighting should as a general rule be avoided, the principal duty being observation. Scouting may be tactical or strategical. By the former, communication is generally kept up with the main fleet by wireless telegraphy or other means, if necessary through intermediate posts. Such posts should preferably consist of heavier cruisers, corresponding to supporting squadrons in cavalry tactics.

For strategical reconnoitering, independent scouting parties are often sent out so far from their base, or from the main fleet, that no communication can be kept up with it, but in such case the scouting squadrons should be accompanied by one or more heavier cruisers. The type suitable for scouting must possess a sea speed sensibly higher than that of the armored cruiser, it must have great endurance and therefore large fuel capacity, and the machinery must not be too fragile. Seaworthiness should be such as to allow long-continued sea service without undue straining of ship or crew. The battery should be sufficiently powerful for fighting other scouts on even terms and for dealing effectively with all torpedo craft.

b. Safety service, which might also be called passive reconnoitering, is a strictly tactical service performed by a line or screen of vessels disposed like advanced guards or outposts in front of the main fleet at a moderate distance, and always in touch with it. The main fleet may be under way or at anchor. The duty of these vessels is to prevent an enemy from approaching unobserved, and to drive back scouts or torpedo craft which try to break through the line. On the approach of a more powerful enemy they are supposed to withdraw until they receive assistance from supporting vessels in rear or from the main fleet.

To the same kind of service belongs also observation of a blockaeded enemy (Port Arthur). Safety service does not require so high speed or so great endurance as scouting, but these qualities, as well as the seaworthiness, should be present in a measure which will enable such vessels to follow the battleship fleets under all circumstances. The armament should be distinctly superior to that of the scouts, the duty of these vessels being not only observation but also resistance.

c. Despatch service, carrying important despatches to or from the commander of a fleet, etc., etc. For this service high speed is the essential requirement, and it may, therefore, generally be performed by scouts or by torpedo vessels.

d. Independent service.—For the same kind of detached service as mentioned for large cruisers, also smaller cruisers will frequently be useful both in time of peace and war. Under most circumstances the types used for scouting and safety service will also be suitable for this service.

THE SCOUT.

The scout is, according to the above, characterized by very high speed, great endurance, and perfect sea-going qualities. In settling the speed, it should be borne in mind that the trial speed taken by itself is only a very imperfect measure of a ship's cruising capability.

By cutting down hull weight and machinery weight, and by forcing the boilers, extreme trial speed may be attained, but it is clear, that if the ship and machinery is to stand the strain of long-continued sea service, there must be a limit in this respect beyond which we ought not to go. This limit can only be determined, in accordance with the claims stated above, by competitive endurance tests of long duration, undertaken in company with armored cruisers under what may fairly be considered average conditions of sea on the ocean. Under such conditions the scout should be able to escape from the armored cruisers, showing an appreciable excess in speed. In the absence of such tests we must use the imperfect measure of a maximum trial speed on the mile, which at present should probably not be less than 25 knots. Turbine machinery should be used. Since the usefulness and safety of this class of ship depend as much on the endurance as on the speed, it is essential that it should be given a great fuel capacity. High speed is of little use if a limited supply of fuel forces a ship to go at a very reduced speed in order to reach its point of destination (Novik).

The fuel supply should be proportioned not to the displacement but to the power, and this ratio should not fall much below what it is in the armored cruisers. A supply of liquid fuel for mixed combustion should be carried. In last year's paper it was pointed out how size, length and freeboard depend upon speed if good nautical qualities are to be secured; these remarks apply with equal force to the cruiser.

For maintenance in the long swell of the ocean of such high speeds as here required, the length of the scout should not be less than that of its natural enemy, the armored cruiser (eventually the battleship-cruiser), i. e., it should approach 500 feet. Also the freeboard must be about equal to that of the armored cruisers, 16-18 feet amidships, giving two complete decks above the protective deck; and in order to permit still higher speeds than the armored cruiser, a low forecastle should be added. Since many fast cruisers are now armed with 4-inch guns (Hamburg), and since this caliber is also well suited for fighting torpedo destroyers, a battery of 4-inch guns seems appropriate for ships of this class. An armament of two submerged torpedo-tubes should be carried besides.

The armor protection should, in accordance with the principles stated at the beginning of this paper, be distributed as in the battleship, and should "correspond" to the gun caliber. The extent and thickness of armor is settled on basis of certain average conditions of fighting, which by way of illustration are here chosen as follows:—

Average fighting distance, 4,500 yards.

Average angle with beam at which projectile strikes the ship, 30°.

Average angle of fall to horizon, 5°.

Average angle of roll of ships, 8°.

If we are to protect the ship under these conditions against the fire from 4-in. guns, we arrive at a water-line belt of 1½-in. nickel steel extending all along the vitals, surmounted up to the gun deck by a strake of ¾-in. of same material. Transverse protective bulkheads of ¾-in. thickness should be placed at extreme ends of ammunition rooms forward and aft. The splinter deck being of the usual sloping type would, if we take the coal protection into account, only need to be ½-in. thick, both on slopes and top. The guns to be protected by 2-in. shields, or preferably mounted in twin turrets. According to recent war experience, special attention should be given to the protection of the steering gear. Coal protection has shown itself to be very effective, and should be made full use of in the arrangement of bunkers along the sides.

By comparison with existing scouts it is found that if the claims here stated are to be fulfilled, the proposed type must have a displacement of about 5,000 tons. It does not appear necessary that ships of this class, even in a great navy, should be very numerous. For scouting, a few vessels well equipped for this service are to be preferred to a greater number of vessels, more or less handicapped by their smaller size in point of sea speed, endurance, and seagoing qualities. It is not here as by safety service a question of covering a given line of observation, but of piercing such a line at one or a few points.

CRUISERS FOR SAFETY SERVICE.

The type required for this service comes very near to the ordinary third class cruiser, possessed by all great navies.

The safety service will generally consist in patroling a certain area or an arc round the main fleet at a distance which permits keeping touch with it. A trial speed of about 20 knots will probably be ample for the performance of this service, and this speed will also enable these vessels to follow a battleship fleet under all circumstances.

The ratio between fuel supply and horsepower should not fall much below that in the battleships, with which these cruisers are to operate.

Turbine machinery and liquid fuel for mixed combustion should be used.

There should be one complete deck above protective deck, with poop and forecastle; freeboard amidships about 10 feet.

The armament should consist of four 5-in. guns and a battery of 3-inch guns. The 5-inch guns will make these ships superior to most scouting cruisers. They should be mounted on poop and forecastle, in twin turrets. Two submerged torpedo-tubes should be carried.

The protection corresponding to the armament under the same average conditions as assumed for the scout, would be:—

Water-line belt, 2-in. nickel steel along vitals, ¾-in. beyond vitals.

Strake above belt up to main deck, ¾-in. nickel steel for length of vitals.

Protective deck, ¾-in. nickel steel all over.
Bulkheads at end of vitals, ¾-in. nickel steel.
Turrets, 3-in. armor.

The displacement of such ships would be about 3,000 tons.

Being powerfully armed and well protected for their size, these vessels will be formidable enemies for all scouts and lighter craft, and, being well suited for many of the various duties which a navy has to perform outside of the tactical service, they will be of great general usefulness. In order to make the safety service effective a great number of patroling vessels is required, and vessels of this class must, therefore, be much more numerous than those of the scout class.

B. Cruisers for Other Than Tactical and Strategical Duties.

The principal of these duties may be defined as follows:

a. Protection of merchant shipping.—When the military navy is much inferior to that of the enemy, protection of commerce is impossible. If it is of about even power or superior, but the enemy is still unbeaten, and even if blockaded, protection of commerce is very difficult to carry out, and is probably best effected by convoys, whereby large fleets of merchant vessels are gathered and accompanied by an escort of warships. Such convoying force must, however, in most cases consist not only of cruisers but also of battleships, and this method, whereby the naval forces are divided, and which is always attended with great risk, would, therefore, hardly be resorted to except in cases where such transport of goods is of vital importance to the country. (Convoy of food supplies from United States to France, 1794.)

Only after the naval power of the enemy is completely broken can there be question of an effective protection of commerce. The escape of cruisers from blockaded ports is, however, always possible, and if they find support and notably facilities of coaling in their own stations or in the ports of a friendly power, they may for a long time prey upon commerce. The best protection against such depredation is probably patroling cruisers; on the ocean, large cruisers of great endurance, distributed for patroling the important trade routes, and occasionally used as convoys; in narrow seas and near ports where trade routes converge, more numerous but smaller vessels of less endurance, covering the whole of the threatened area. The former type must carry an armament enabling it to fight armored cruisers; the latter should be capable of driving off all light, fast cruisers.

b. Commerce destroying.—For commerce destroying on the ocean, cruisers of high speed and great endurance are required; near a base smaller vessels with less endurance may be used. The speed should be sufficient to enable them to escape from larger cruisers. Since fighting with other warships should generally be avoided, the armament may be very light.

c. Blockading of commercial ports. Visitation and search of merchant vessels.—In order to catch blockade runners and to carry out visitation and search so as to prevent contraband of war being carried to the enemy's ports, ships of high speed and light armament are needed.

CHOICE OF TYPES.

For protection of shipping on the ocean no better type could be conceived than the battleship-cruiser; its high, sustained speed and superior fighting power will make it a dreaded enemy for all other classes of cruisers. Once the enemy's main fleet is beaten and driven in port, the battleship-cruisers may generally be spared for this service.

For protection of shipping near ports, whether at home or in the colonies, cruisers of intermediate size (second class) are appropriate. The seaworthiness and endurance, and hence the size, will depend on the nature of the seas in which they are to operate. The fighting power must depend somewhat on the position and nature of the station, but must always be sufficient to drive off all third-class cruisers. The protection should correspond to the armament, i. e., the cruisers should be "armored." The displacement would, according to circumstances, be from 5,000 to 10,000 tons. Ships of these classes, which are not well suited for the purely military service, are hardly needed in large number by any other country than England, i. e., under present conditions.

For commerce destroying on the ocean first-class armored cruisers are by many considered the best type, since their fighting power gives them great independence. It appears, however, that not until all hope of defeating the enemy's military navy has been abandoned would it be justifiable to detail such powerful ships for this service.

Since great dissemination and high speed of the attacking cruisers are the chief requirements, while fighting power is of small importance, the scout, such as proposed above, seems a more appropriate type for this service.

For attack on commerce in narrow seas, as well as for blockade and visitation service, the scouts and also such smaller cruisers as above proposed for safety service may be used.

SUMMARY AND CONCLUSIONS.

We have seen from the historical review how the development of cruisers has been controlled largely by regard to war on commerce. It has been pointed out that the primary object of naval warfare is to break the naval military power of the opponent, in order thereby to obtain control of the ocean, since such control carries with it the attainment of all other desired objects, also control of commerce.

This latter object must, therefore, be secondary, as far as naval operations are concerned, even although it may in some cases be of vital and, therefore, primary importance to the country. The ship building policy should follow the same lines, first providing cruisers suitable for military service and, secondly, for commerce protection or commerce destroying. To reverse this order of precedence can only be done to the detriment of the general usefulness of a navy.

This policy, being based on fundamental strategical principles, should be followed by all countries.

For a country like the United States, which has little commerce on the ocean to protect, and to whom the inconclusive and barbarous method of warfare, called commerce destroying, is not likely to appeal, it appears that the ship building policy should be directed exclusively towards purely military objects.

By an analysis of the duties which belong to cruisers in a war between military navies, it should be determined which of these duties are the most important, and on basis of these the proposed types of cruisers should be chosen. This is what has been done in the paper, with the result that a few types appear to be sufficient for all strictly military duties, viz (see plate):

1. Battleship-cruisers, of same military strength as ordinary battleships, but of higher speed. (About 20,000 tons, 21 knots.)
2. Scouts of extreme speed, great endurance, perfect sea-going capability, and light armament. (About 5,000 tons, 25 knots.)
3. Small cruisers of moderately high speed, fair endurance, relatively powerful armament and protection. (About 3,000 tons, 20 knots.)

The two first types are required only in small number, the last type in greater number.

The building of other special types, not perfectly suited to the primary service of a navy, implies reduced military strength and increased expenditure, and should be adopted only where absolutely necessary.

The present type of first-class cruiser (Tennessee, Minotaur, and Edgard Quinet), although useful in many cases, does not seem indispensable for any particular service, and is ill suited for its most important duty, participation in fleet actions, and it should, therefore, be abandoned.

Second class cruisers appear to be useful or necessary only to those navies which, like the English, have a great ocean trade to protect. For a navy like that of the United States it would, therefore, seem unnecessary and uneconomical to multiply cruiser types beyond the three here proposed.

Considerable stir has been causd in Hamburg by the announcement that a new steamship line, to be called the Roland Line, and having a capital of 9,000,000 marks, has been formed at Bremen for the purpose of trading between that port and Chili and Peru. This news is made public simultaneously with the confirmation of the report that another Bremen line, the well-known Kosmos Steamship Company, has arranged to start the new service between Bremen, Baltimore, and New York. It will be exclusively a freight and emigrant service. Bitter complaint is made of the aggressive tactics of the Bremen people, who, it seems, are not only establishing new lines to the United States and South America with cutting rates, but are also invading the Hamburg preserves in the Australian and Javan trades. The North German Lloyd is denounced for the support which it is giving the Atlas Line.

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Chicago Ship Building Co............Chicago.
Craig Ship Building Co............Toledo, O.
Cramp, Wm. & Sons...........Philadelphia.
Detroit Ship Building Co.............Detroit.
Great Lakes Engineering Works......Detroit.
Lockwood Mfg. Co........East Boston, Mass.
Milwaukee Dry Dock Co..........Milwaukee.
Newport News Ship Building Co.........
.....................Newport News, Va.
Shipowners Dry Dock Co............Chicago.
Superior Ship Building Co....Superior, Wis.
Tietjen & Lang Dry Dock Co.....Hoboken, N. J

DREDGE BUILDERS.
Manitowoc Dry Dock Co........Manitowoc, Wis.

DYNAMOS.
General Electric Co...........Schenectady, N. Y
Mietz, Aug..............................New York.
Thropp & Sons, John E............Trenton, N. J.

ELECTRIC HOISTS AND CRANES.
General Electric Co........Schenectady, N. Y.

WANTED and FOR SALE Department.

PROPOSALS.

PROPOSALS FOR TWO SNAGBOATS.—U. S. Engineer Office, Vicksburg, Miss., Jan. 8, 1906. Sealed proposals, in triplicate, for construction and delivery of two steel snagboats will be received here until 12 noon, standard time, March 10, 1906, and then publicly opened. Information furnished on application. G. M. Hoffman, Capt. Engineers.

FOR SALE.

For Sale

Steamer Oregon lying in Milwaukee; Length of keel, 197 ft.; beam, 33 ft.; depth of hold, 13 ft. 9 in. Built in 1892, rebuilt 1903. Registered tonnage, 779 gross, 557 net. Boiler built in 1887, M. Riter, Buffalo, 16 ft. long, 120 inches diameter, allowed 100 pounds steam. Engine steeple compound, 20 x 40, 32 inch stroke. Capacity, lumber average 735 M ft.; wheat, 41,000; hard coal, 1200; soft coal, 1150; ore, 1100. J. A. CALBICK & CO., 44,-2 Sherman St., Chicago, Ill.

FOR SALE.

One combination Clamshell and Dipper Dredge. Machinery for clamshell dredge. A dipper dredge partly burned. Deck scow 112 x 32 x 9. Tug—14 x 16. Several dredge dippers. Three 100-yd. dump scows. Miscellaneous appliances. Office with safe and fixtures, all to be closed out cheap.

CARKIN, STICKNEY & CRAM.
DETROIT, MICH.

FOR SALE.

For Sale.

Five Scotch Boilers, allowed 160 lbs. steam. Good as new. ERIE MACHINERY CO., 729 Garfield Bldg., Cleveland, O.

For Sale.

Schooner Columbian, 338 net tons, $600. She has had stanchions, nearly all rails covering beards, and nearly five streaks of plank since 1889. Deck and 20 beams two years old. Inquire E. J. CUYLER, Oberlin, O.

For Sale.

Tug Fashion, 65 ft. long, 16 ft. wide, 7½ ft. depth. Allowed 125 pounds steam. New decks and bulwarks last year. Engine 16 x 16. A bargain.
DORMER-BOUTIN FISH CO.,
Bayfield, Wis.

Steam Barge for Sale.

For Sale.—Steam barge, 131 ft. keel, 25 ft. beam, 9 ft. deep. Capacity, lumber, 260 M ft.; coal, 400 tons. Good power; can handle two or three barges. Everything pertaining to this boat is in good condition. Terms cash. Address Lock Box 35, St. Clair, Mich.

WANTED.

Small Steam Barge,

carrying about 250 tons of coal. Either American or Canadian bottom. Give particulars and price. Address "S. B.," 2417 Lawrence ave., Toledo, O.

Wanted.

Small light draft Steam Barge, carrying capacity 350 to 400 tons.
Address "C. D.," Oswego, N. Y.

Dredge Wanted.

Wanted a small dredge that will work in about three feet of water.
THOS. GILLESPIE,
Sturgeon Bay, Wis.

Buyers' Directory of the Marine Trade.—*Continued.*

ELECTRIC LIGHT AND POWER PLANTS.
General Electric Co.......Schenectady, N. Y.
Mietz, Aug. ....New York.
Sturtevant, B. F. & Co......Hyde Park, Mass.
Thropp & Sons, John E.......Trenton, N. J.

ENGINE BUILDERS, MARINE.
American Ship Building Co........Cleveland.
Atlantic Works..........East Boston, Mass.
Chicago Ship Building Co..........Chicago.
Chase Machine Co................Cleveland.
Cramp, Wm. & Sons...............Philadelphia.
Craig Ship Building Co...........Toledo, O.
Detroit Ship Building Co.............Detroit.
Fletcher, W. & A. Co.........Hoboken, N. J.
Fore River Shipbuilding Co....Quincy, Mass.
Great Lakes Engineering Works.Detroit, Mich.
Hall Bros. ....Philadelphia.
Lockwood Mfg. Co.........East Boston, Mass.
Maryland Steel Co.......Sparrows Point, Md.
Mietz, Aug.......................New York.
Milwaukee Dry Dock Co..........Milwaukee.
Mosher, Chas. D.................New York.
Moulton Steering Engine Co.......New York.
Newport News Ship Building Co.........
.....................Newport News, Va.
New York Shipbuilding Co....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co...
.... Duluth, Mich.
Quintard Iron Works Co...........New York.
Roach's Ship Yard...............Chester, Pa.
Sheriffs Mfg. Co.................Milwaukee.
Superior Ship Building Co....Superior, Wis.
Thropp, J. E. & Sons Co......Trenton, N. J.
Trout, H. G.........................Buffalo.

ENGINE ROOM TELEGRAPH, CALL BELLS, ETC.
Cory, Chas. & Son................New York.
Marine Mfg. Supply Co...........New York.

ENGINEERING SPECIALTIES AND SUPPLIES.
Kieley & Mueller ....New York.
Lunkenheimer Co. ....Cincinnati.
Northwestern Steam Boiler & Mfg. Co...
.... Duluth, Minn.

ENGINEERS, MARINE, MECHANICAL, CONSULTING.
Hynd, Alexander ....Cleveland.
Hunt, Robt. W. & Co...............Chicago.
Kidd, Joseph..................Duluth, Minn.
Mosher, Chas. D..................New York.
Nacey, James ....Cleveland.
Roelker, H. B. ....New York.
Wood, W. J. ....Chicago.

FEED WATER PURIFIERS AND HEATERS.
Greacen-Derby Engineering Co.............
.......................Perth Amboy, N. J.
Ross Valve Co..................Troy, N. Y.

FIRE EXTINGUISHERS.
Safety Fire Extinguisher Co.......New York.

FIXTURES FOR LAMPS, OIL OR ELECTRIC.
General Electric Co.......Schenectady, N. Y.

FORGES.
Sutton Co., C. E..................Toledo, O.

FORGINGS FOR CRANK, PROPELLER OR THRUST SHAFTS, ETC.
Cleveland City Forge & Iron Co...Cleveland.
Fore River Shipbuilding Co.....Quincy, Mass.
Macbeth Iron Co.................Cleveland.

FLUE WELDING.
Fix's, S. Sons.....................Cleveland.

FUELING COMPANIES AND COAL DEALERS.
Hanna, M. A. & Co...............Cleveland.
Ironville Dock & Coal Co..........Toledo, O.
Parker Bros. Co., Ltd..............Detroit.
Pickands, Mather & Co............Cleveland.
Pittsburg Coal Co.................Cleveland.
Smith, Stanley B., & Co............Detroit.
Smith Coal & Dock Co., Stanley B. Toledo, O.

FURNACES FOR BOILERS.
Continental Iron Works..........New York.

GAS BUOYS.
Safety Car Heating & Lighting Co..New York.

GAS AND GASOLINE ENGINES.
Chase Machine Co...............Cleveland.

GAUGES, STEAM AND VACUUM.
Lunkenheimer Co. ....Cincinnati.

GAUGES, WATER.
Bonner Co., Wm. T..................Boston.
Lunkenheimer Co. ....Cincinnati, O.

GENERATING SETS.
General Electric Co..........Schenectady, N. Y.

GRAPHITE.
Dixon Crucible Co., Joseph..Jersey City, N. J

GREASE EXTRACTORS.
Greacen-Derby Engineering Co.............
.......................Perth Amboy, N. J.

HAMMERS, STEAM.
Chase Machine Co................Cleveland.

HEATING APPARATUS.
Sutton Co., C. E..................Toledo, O.

HOISTS FOR CARGO, ETC.
American Ship Building Co........Cleveland.
Brown Hoisting Machinery Co. (Inc.)....
.... Cleveland.
Chase Machine Co...............Cleveland.
General Electric Co...............New York.
Georgian Bay Engineering Works........
..........................Midland, Ont.
Hyde Windlass Co.................Bath, Me.
Marine Iron Co.....................Bay City.
Mietz, Aug. ....New York.

HOLLOW SHAFTINGS, IRON OR STEEL.
Falls Hollow Staybolt Co...Cuyahoga Falls, O.

HOLLOW STAYBOLT IRON.
Falls Hollow Staybolt Co...Cuyahoga Falls, O.

HYDRAULIC DREDGES.
Great Lakes Engineering Works......Detroit.

HYDRAULIC TOOLS.
Watson-Stillman Co., The.........New York.

ICE MACHINERY.
Great Lakes Engineering Works......Detroit.
Roelker, H. B...................New York.

INJECTORS.
American Injector Co...............Detroit.
Jenkins Bros. ....New York.
Lunkenheimer Co................Cincinnati.
Penberthy Injector Co.........Detroit, Mich.

INSURANCE, MARINE.
Elphicke, C. W. & Co..............Chicago.
Fleming & Co., E. J.................Chicago.
Gilchrist & Co., C. P.............Cleveland.
Hawgood & Co., W. A.............Cleveland.
Helm & Co., D. T...................Duluth.
Hutchinson & Co..................Cleveland.
McCarthy, T. R...................Montreal.
McCurdy, Geo. L...................Chicago.
Mitchell & Co....................Cleveland.
Parker Bros. Co., Ltd..............Detroit.
Peck, Chas. E. & W. F..New York & Chicago.
Prindiville & Co....................Chicago.
Richardson, W. C................Cleveland.
Sullivan, D. & Co.................Chicago.

IRON CASTINGS.
Sutton Co., C. E..................Toledo, O.

IRON ORE AND PIG IRON.
Bourne-Fuller Co.............Cleveland, O.
Hanna, M. A. & Co...............Cleveland.
Pickands, Mather & Co............Cleveland.

LAUNCHES—STEAM, NAPHTHA, ELECTRIC.
Truscott Boat Mfg. Co.....St. Joseph, Mich.

LIFE PRESERVERS, LIFE BOATS, BUOYS.
Armstrong, Cork Co...............Pittsburg.
Drein, Thos. & Son.........Wilmington, Del.
Kahnweiler's Sons, D..............New York.

LIGHTS, SIDE AND SIGNAL.
Russell & Watson ....Buffalo.

LOGS.
Nicholson Ship Log Co...........Cleveland.
Walker & Sons, Thomas....Birmingham, Eng.
Also Ship Chandlers.

LUBRICATING GRAPHITE.
Dixon Crucible Co., Joseph..Jersey City, N. J.

LUBRICATORS.
Lunkenheimer Co. ....Cincinnati

LUMBER.
Martin-Barriss Co..................Cleveland.

MACHINISTS.
Chase Machine Co..................Cleveland.
Hickler Bros.........Sault Ste. Marie, Mich.
Lockwood Mfg. Co........East Boston, Mass.

MACHINE TOOLS (WOOD WORKING).
Atlantic Works, Inc.............Philadelphia.

MARINE RAILWAYS.
Hickler Bros.........Sault Ste. Marie, Mich.

MARINE RAILWAYS, BUILDERS OF.
Crandall & Son, H. I.....East Boston, Mass.

MATTRESSES, CUSHIONS, BEDDING.
Fogg, M. W.....................New York.

MECHANICAL DRAFT FOR BOILERS.
American Ship Building Co........Cleveland.
Detroit Ship Building Co.............Detroit.
Great Lakes Engineering Works......Detroit.

METALLIC PACKING.
Katzenstein, L. & Co.............New York.

MOTORS, GENERATORS—ELECTRIC
General Electric Co.......Schenectady, N. Y.

NAUTICAL INSTRUMENTS.
Benjamin Farnum How..................Boston
Ritchie, E. S., & Sons......Brookline, Mass.

NAVAL ARCHITECTS.
Hynd, Alexander ....Cleveland.
Kidd, Joseph ....Duluth, Minn.
Mosher, Chas. D.................New York.
Nacey, James ....Cleveland.
Wood, W. J. ....Chicago.

OAKUM.
Stratford, Oakum Co.......Jersey City, N. J.

OIL ENGINES.
Mietz, Aug. ....New York.

OILS AND LUBRICANTS.
Dixon Crucible Co., Joseph..Jersey City, N. J.
Standard Oil Co...................Cleveland.

PACKING.
Jenkins Bros. ....New York.
Katzenstein, L. & Co.............New York.

PAINTS.
Baker, Howard H. & Co.............Buffalo.
Upson-Walton Co. ....Cleveland.

PATTERN SHOP MACHINERY.
Atlantic Works, Inc............Philadelphia.